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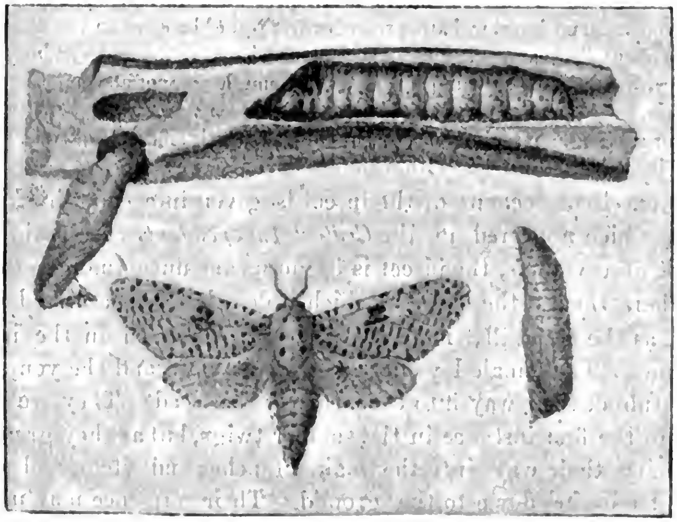
MISCELLANEOUS NOTES.

By E. C. Cotes, *Offg. Deputy Superintendent, Indian Museum.*

Boring insects in sandal wood and tea stems.

A good deal of damage is said to have been done in 1891 to young sandal wood (*Santalum album*) trees in Mysore by a boring insect. According to a report, dated 13th July 1891, by the Assistant Conservator of Forests, Mysore, furnished through the Director of the Dehra Dun Forest School, this borer attacks both the stem and the roots, either killing the sapling outright or weakening it, so that it is liable to get blown over by the wind. Sandal wood yields an important revenue to the Mysore State, so that any damage done to the young trees is of consequence.

The insect that seems to be chiefly responsible for the damage is the caterpillar of the moth *Zeuzera coffeæ* Nietner, a species which occasionally attacks both coffee (*Coffea arabica*) and tea (*Camellia theifera*) bushes.



Some Coleopterous larvæ, however, which appear to be *Tenebrionidæ*, have also been received, but are not thought likely to have played more than a subordinate part in injuring the sandal wood saplings. The identity of the insect was made out from a moth which emerged in the Museum, on 9th February 1892, from some affected sandal wood stems that were kindly furnished by Mr. J Cameron, Superintendent of the Government Gardens, Bangalore. The only suggestion that could be made for dealing with the insect was to cut out and burn the infested stems and thus prevent the spreading of the pest. The figure shows the various stages of the *Zeuzera* with a piece of wood bored by it, all natural size.

A very closely allied or identical caterpillar was sent to the Museum in March 1891 by Messrs. Andrew Yule & Co., with the information that it had been doing a good deal of damage to the stems of tea (*Camellia theifera*) bushes in the Jorhat district of Assam.

The species *Zeuzera coffeæ* is figured and described in Moore's Lepidoptera of Ceylon, page 154, pl. 143, fig. 1. It was originally described by Nietner in his pamphlet on the enemies of the coffee tree in Ceylon, in 1861.

The following is an extract from Mr. Green's edition of Nietner's pamphlet, page 14—

"This insect...........destroys many trees, young and old, the caterpillar eating out the heart: for this purpose it generally enters the tree six or twelve inches from the ground, ascending upwards. Fortunately it is not abundant. It resembles the caterpillar of the goat-moth of England, is two inches long, and as thick as a goose-quill, nearly naked, of yellowish colour, back red, head thoracic and anal plates blackish; when full-grown the colours are light and dirty. The sickly, drooping foilage, and a heap of globules of conglomerated wood-dust at the foot of a tree soon indicate that the caterpillar is carrying on its destructive work inside. The chrysalis rests three months, and its skin half protrudes from the hole when the moth escapes, which is about February. The moth measures $1\frac{3}{4}''$ across the wings, which are white, spotted with steel blue ; the upper ones, with one large spot and numerous series of small ones, placed in rows between the nerves ; the lower wings are less spotted. Thorax with four spots near margin. Abdomen variegated with blue. Legs blue, second pair with white femora, third pair with white femora and tibiæ."

An excellent account of the insect is given in a paper by Mr. E. E. Green, which appeared in the *Ceylon Independent*. According to Mr Green's observations, the insect is by no means uncommon on tea estates in Ceylon, though the damage which it does is often ascribed to other causes, as the caterpillar is very completely concealed in the interior of the stems. The female lays her eggs in the bark, and the young caterpillars tunnel their way into the heart of the wood. They are generally found in the first instance in the smaller twigs, but as they grow bigger, they make their way into the main branches and stem, and often kill young tea bushes down to the ground. Their presence may usually be detected by the heaps of sawdust-like excrement to be found on the ground under the bush. Mr. Green notices that according to his own observations the moth does not emerge at any one particular time of the year.

Tea defoliator in Jorhat.

In April 1891 specimens were furnished by Messrs. Andrew Yule & Co. of an insect which had proved destructive to tea (*Camellia theifera*) in the Jorhat district of Assam. The manager of one of the gardens wrote that he had been getting 25 two-maund bags of these caterpillars picked off the bushes

daily, but that in spite of all his efforts they seemed rather to increase in numbers. They stripped the leaves and the bark off the bushes to such an extent as in some cases to kill the plants. The manager added that during the ten years he had been in the district he had never seen such a visitation, and that his coolie sirdars, some of whom had been over 20 years on the garden, could not remember the like. The specimens that were forwarded were found to be the larvæ of a Bombyces moth which is thought to belong to the family Arctiidæ. The insect does not appear to have been previously sent to the Museum as attacking tea, and it cannot be identified precisely without an examination of the moth into which the caterpillar transforms The fact that it has not previously been reported as attacking tea makes it pretty certain that it is not a species likely to do any very extensive injury. To enable the moth to be reared for identification in the Museum it would be desirable to obtain some live full-grown caterpillars or better chrysalids. They would probably reach Calcutta alive if they were lightly packed with a few tea shoots and sent direct in a perforated box or basket. The caterpillar could no doubt be easily destroyed by spraying the tea bushes with an insecticide, but this method of treatment does not seem to be generally looked upon favourably by tea planters, and it is very doubtful to what extent it would be desirable in the present instance, on account of the poisonous nature of most of the preparations.

White grub in Sikkim.

In October 1891 a number of Melolonthidæ larvæ (=*cockchafers* or *white grubs*) were forwarded to the Museum by Messrs. Davenport & Co., with the information that they had appeared in vast numbers in some of the hill tea (*Camellia theifera*) gardens, and were making great havoc among the young tea plants. In one case the insect was said to have practically destroyed 100 acres of young tea as fast as it was planted. The prevalence of the pest was attributed to the abnormally dry weather. An attempt was made to rear the insect in the Museum for precise identification, and in February 1892 a mature specimen emerged in the rearing cage. It was found to be identical with a species which was determined some years ago through Dr. Günther as *Lachnosterna impressa* Burmeister. It is therefore the insect which appeared in vast numbers and proved very destructive in Darjeeling in the year 1883. In Ceylon coffee estates, where allied insects proved very destructive about a dozen years ago, the only method of treatment that was at all successful was digging out the grubs by hand, and this, though very costly, was generally admitted to be the most satisfactory method of dealing with the pest. Attempts have recently been made in Europe to destroy *white grubs* by innoculat-

ing them with the spores of a fungoid disease to which they are subject. This method of treatment however has not yet passed beyond the experimental stage, so it cannot be recommended for practical purposes. In the case of a species which attacks the roots of vines in Europe, bisulphide of carbon has been recommended, and this chemical seems likely to prove of practical utility. The simplest method of treatment was to make a hole near the main root of the vine by forcing a small stick into the earth, then to pour about half a teaspoonful of bisulphide of carbon into the hole, and plug it tightly with earth pressed down by the foot; and more elaborate methods which are said to have been successfully adopted in French vineyards for fighting phylloxera with bisulphide of carbon would no doubt be equally effective for dealing with white grub in Sikkim. According to Mayet (Insectes de la vigne 1890), as quoted in a recent report by Mr. Charles Whitehead: "the bisulphide is put into the ground in two or three holes close round the roots of each vine, with a kind of hand pump (*pal*) terminating in a tube with a short point having an orifice near its end. This is thrust into the earth, and the liquid is forced into the hole by pressure from the pump."

Cask borers in India.

The damage done to beer casks in India by minute beetles which drill holes into the staves, has attracted a good deal of attention during the past few years. Mr. W. F. H. Blandford, F. E. S., Lecturer on Entomology at the Indian Civil Engineering College, Cooper's Hill, has for some time been investigating the subject, and asks for co-operation in procuring further information.

The subject is a complicated one, as the casks are attacked by several distinct insects, some of which are more destructive than the others. In the case of the casks dealt with in an interesting report by Mr. Blandford, which appeared in the Bulletin of Miscellaneous Information, Royal Gardens, Kew (September 1890), the damage was attributed to a Scolytid of the genus *Trypodendron*—species *domesticum* Linn, also *signatum* Fabr.-*quercus* Eich. These insects are natives of Europe, where they attack newly felled timber. From this, and also the fact that some of the holes in the casks examined were found to be covered up by iron cask hoops, which fitted so tightly that it was quite impossible for the insect to have begun to bore after the hoops were put on, Mr. Blandford concluded that the cask was attacked before ever it was filled with beer and shipped. In the case of a further consignment, however, afterwards received, the damage appears to have been done either on board ship or in India by a Scolytid of the genus *Xyleborus*. The species *Xyleborus perforans* Wollast. was the one recognised by Mr. Blandford; it is no doubt the same insect as the cask borer from Rangoon, referred to in the Proceedings of the Entomological Society of London, 1882, p. xvi, as

Xyleborus saxeseni Ratz and it is thought to be the one that does most of the damage to the casks.

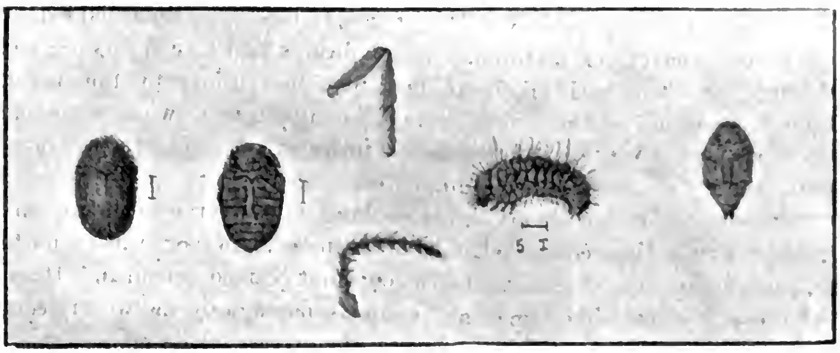
The *Xyleborus* beetles, which attack stored casks, can be easily distinguished from the *Tripodendron* beetles, which attack green wood, by the fact that the *Xyleborus* is very much smaller than the *Tripodendron* (3 mil. long by 1 mil. broad, against 4 mil. long by 2 mil. broad), and also by the shape of the burrow, which in the *Xyleborus* branches a good deal, while in the *Tripodendron* the straight tunnel made by the parent has only a number of little chambers eaten out around it by the larvæ.

The above is a sketch of the question as it stands at present, but several of the points are still uncertain, and as it is obviously of importance to determine whether the damage is due to original unsoundness in the casks or to subsequent injury in store, Mr. Blandford is taking up the whole question and collecting information with a view to settling it definitely. He will be grateful for any help that is given him in the matter, and writes that the chief points upon which he requires information are: (1) if the barrels are attacked on board ship, or in transport, or in store: (2) whether the beetle is confined to beer casks or also attacks other timber: (3) any particulars about the life history of the insect and the extent to which it gives trouble in Indian breweries.

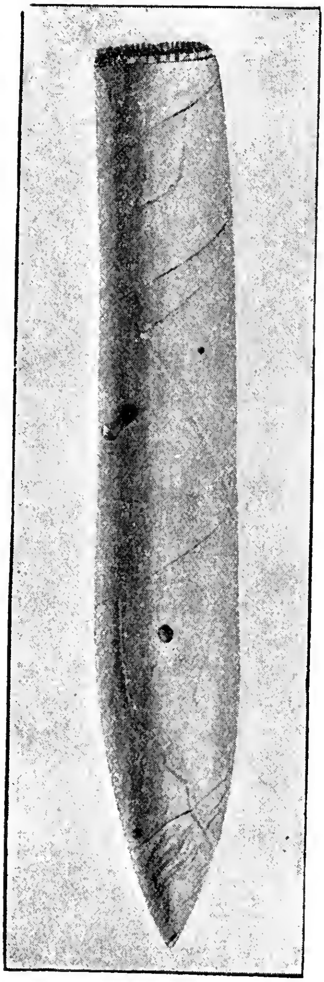
Postscript.—Mr. H. M. Phipson of Bombay writes—(January 1892), that the Inspectors at the Commissariat office in Bombay all say that of late they have not been troubled with the borer. They agree that two or three years ago, when so many of the casks were attacked, the casks were in the majority of cases found to be leaking, on being landed, so it would appear that the insect commences its operations on board ship.

Cheroot borer.

In the rainy season of 1891 attention was again called to the "cheroot weevil," *Lasioderma testaceum* Redtenb. (Dermestidæ). This insect drills the



small round holes which are so often met with in Indian cheroots, and



is said to interfere very seriously with the exportation of Indian cheroots. So far as is known the beetle lays its eggs on the leaf, and the little curved white hairy grubs, which emerge from these eggs, tunnel their way through the tobacco, and finally transform into white motionless pupæ from which the beetles emerge ready to cut their way out of the cheroot, and thus form the round holes which are so characteristic a sign of the presence of the insect. The length of time spent by the insect in its various stages has not yet been traced, and there is still a good deal of doubt as to the stage in the manufacture at which the eggs are usually laid. In some old broken-up cheroots, kindly furnished by Mr. G. W. L. Caine, in August 1891, were found both some very young larvæ and also two minute eggs which were thought to belong to this species. The eggs were transparent-white in colour, showing the yolk cells by transmitted light. They were oval in shape, with a number of minute protuberances at one pole, and they measured, one of them, about a fifth, and the other about a third of a millimetre in length. They were found loose amongst the broken pieces of tobacco leaf. The eggs were evidently alive when found, and their presence in the old cheroots goes to show that eggs are at least sometimes laid after the cheroots have been matured. This indicates that care in packing and storing the cheroots is likely to tend to reduce injury by the insect, though it would not of course prevent damage in cases where eggs had been laid on the leaf before it was made into cheroots. It was suggested that, subjecting the cheroots to a temperature of 80 or 90 degrees centigrade for a few hours before packing, might serve to destroy any eggs or grubs they contained. This treatment, however, was found to injure the flavour of the cheroots, so could not be recommended. Upon the whole, the most likely means of reducing damage by the weevil seem to be—firstly, to keep the leaf, during the process of its manufacture, as much as possible out of the way of old cheroots and refuse tobacco of

all kinds where the insect is likely to breed; and, secondly, to pack the cheroots in as air-tight a manner as possible, so as to prevent the mother beetles getting into the boxes to lay their eggs. The insect is known to attack stored rice, opium, and other vegetable substances, as well as tobacco, so the cleaning up of the manufactory should be as thorough as possible. The figures show the various stages of the insect, also a cheroot tunnelled by it. The size of the insect is indicated by hair lines.

Coconut blight.

In May 1891 specimens of scale insects, destructive to cocoanut trees in the Laccadive Islands, were forwarded to the Museum by Mr. Edgar Thurston, who had received them from Mr. W. Dumergne. Mr. Dumergne found the cocoanut (*Cocos nucifera*) trees at Aneutta attacked by what was thought to be a disease. Some years previously the same disease was said to have carried off thousands of trees in the Laccadives, thus seriously damaging almost the only product of these islands. Mr. Dumergne was told that the first symptom of the disease had been an army of ants. The leaves, when attacked, were said to turn a sickly brownish-yellow and gradually shrivel up, the tree itself succumbing altogether in a very short space of time.

The leaves furnished were found to be thickly beset with Coccidæ (scale insects) which would be quite sufficient to account for the injury reported. The ants no doubt merely attend the Coccidæ for the sake of the secretion yielded to them by so many species of this group of insects, and they have therefore nothing to do with the injury to the cocoanut trees.

With regard to remedies, the most successful method of destroying scale insects on trees is generally agreed to consist in spraying them with the kerosine and soap emulsions described in earlier numbers of these *Notes*. It is difficult, however, to say to what extent such treatment would be practicable in the present instance; especially as experiments, recently made in the United States, have shown the extreme difficulty in completely eradicating scale insects from palm trees, on account of the large amount of shelter which is afforded to the insects in the crevices between the folds of the leaves.

With a view to obtaining the identification of the scale insect concerned, the specimens were submitted to Mr. W. M. Maskell, who has kindly examined them and furnished an interesting note upon the subject. Mr. Maskell found that the leaves were infested by two distinct insects belonging to two different genera—Dactylopius and Aspidiotus. The former, in which each insect has white cottony secretion is so near to *Dactylopius cocotis* Maskell, that Mr. Maskell considers it identical or at most a variety (see p. 66). The latter was found by Mr. Maskell to be undoubtedly *Aspidiotus destructor* Signoret, in which a distinguishing character is the comparative smallness of the two

median abdominal lobes in the female. This insect is stated by Signoret to have been dreadfully injurious to cocoanut trees in the Isle de la Réunion.[1] For further particulars see p. 66.

Wheat-stalk borer.

In January 1892 the Superintendent, Government Farms, Nagpur, forwarded wheat (*Triticum sativum*) leaves from fields which were said to be suffering to a very large extent from some disease or insect attack. Little could be made of the specimens, though the remains of a number of minute creatures which appeared to be Collembola (order Thysanura) were found upon the leaves. These insects were not thought to be sufficient to occasion the damage that was reported. In February, however, a number of green wheat stalks were forwarded. These had their stems tunnelled by the caterpillars of a Microlepidopterous moth, either identical with, or very closely allied to, the paddy borer *Chilo sp.* described on page 19 of Volume II of these *Notes*, as attacking paddy in the Bombay Presidency.

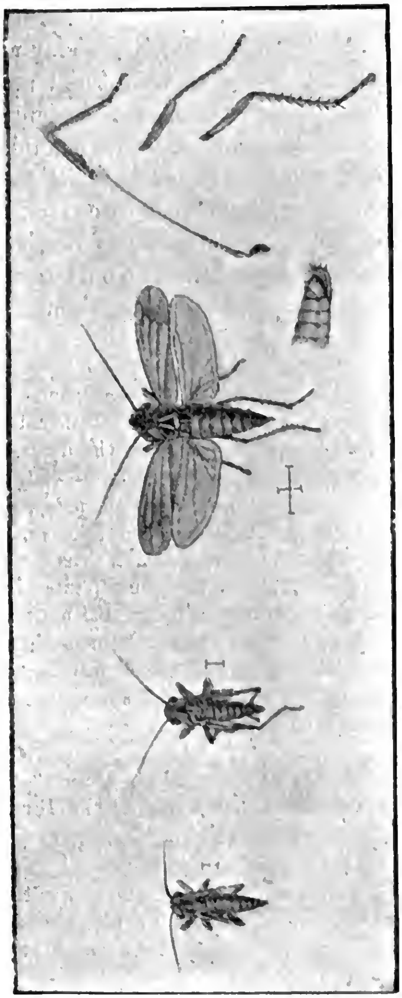
A series of specimens, illustrative of the same wheat borer, were forwarded by Mr. Mollison, Superintendent of Farms in the Bombay Presidency. According to an interesting note by Mr. Mollison, dated 23rd February, a considerable amount of damage had been done by the insect in experimental plots of wheat on the Government Farm, Poona. The caterpillars were found inside the stalk, usually in the hollow of the straw above the node nearest to the ear. The first symptom of attack that was noticed was a bleaching of the ear and stalk down to the point where the caterpillar was at work, while the lower part of the plant remained green and healthy. Several varieties of wheat were being experimented with in small adjacent plots, and one plot of wheat that ripened sooner than the other was not affected, while none of the plants were noticed as attacked until they were within it about ten days of ripening. The wheat followed green peas, and the wheat seed from which these plants were raised had been grown on the farm the preceding year. The specimens arrived in excellent condition, the caterpillars reaching the Museum alive, so it is hoped to rear this moth for identification. It will be interesting to ascertain whether this paddy borer, which attacks the rice crop in the rainy season, is the same as the caterpillar which attacks wheat in the cold weather. In the case of the paddy borer, which did some damage in the Bombay Presidency last year, there was reason to suppose that the insect passed through a number of generations in the course of the year, hybernating in the self-sown paddy and large grasses, around the paddy

[1] The success which has attended the experiments made by the United States Entomological Department in importing *Vedalia* beetles (*Coccinellidæ*), at first from Australia into California, and afterwards from California into Egypt and New Zealand, for the destruction of the scale insect *Icerya*, would seem to indicate the desirability of ascertaining whether, in the Isle de la Réunion, the palm scale is attacked by any Coccinellid which might be worth importing into the Laccadives.

fields. It was therefore recommended to keep down the self-sown paddy and large grasses as much as possible, with a view to reducing the number of moths that would be liable to lay their eggs on the paddy crop. The efficiency, however, of such measures will obviously be much reduced if the wheat fields prove to be a breeding place of the insect. Even if this should turn out to be the case, however, the clearing of the fields during the hot weather, when neither wheat nor paddy are being grown, would seem likely to be useful.

Green fly tea blight.

A good deal of damage was done in the early part of the tea making season of 1891 in Assam by an insect which is known as the *green fly* or *blister blight*. Specimens were sent to the Museum from several gardens in Assam, and some were also obtained, through the courtesy of the Calcutta Agri.-Horticultural Society, from the Darjeeling tea district. The specimens from the different localities were all identical, and proved to belong to a species of leaf hopper which is included in the family Jassidae. The insect therefore is allied to the *Idiocerus niveosparsus*, Leth. which has previously been reported as injurious to mango (*Mangifera indica*) blossom in India. Specimens of the tea insect were sent to Mons. Lethierry of Lille for precise identification. Mons. Lithierry very kindly examined them and reports that they belong to the species *Chlorita flavescens* of Fabricius and Fieber. He adds that the insect is fairly common in Europe, and that he has also received specimens of it from Algeria, Brazil, and Siberia, so it may be looked upon as practically cosmopolitan.



From the accounts that have been received from Assam, it appears that the insect attacks the young tea shoots and sucks their

juices to such an extent as to stunt their growth and prevent their attaining anything like their natural size. It is also said to cause the white blister-like patches that are found on the more mature tea leaves. It is said to have done serious damage in tea gardens both in Cachar and in the Upper Assam valley. It appeared in the early part of the season, and (at least in the Upper Assam valley) is said only to have lasted until the middle or end of June. Cold damp seasons are thought to favour its increase. No remedy seems to have been found that was of any use. The insects were not attracted by lamp traps placed amongst the bushes, and were so active and difficult to catch that hand-picking was out of the question. Extra hoeing was adopted in one case with a view of increasing the vigour of the tea plants, and thus of helping them to throw off the blight, but it is not said whether this did any good.

According to a report, dated 19th June 1891, by Mr. G. F. Playfair of Cachar, kindly furnished through Messrs. Barry & Co., the insect stops the growth of the young shoots, and prevents their ever becoming fit for plucking. The effect of the pest was said to be deplorable. Over whole sections of the tea garden the plants were covered with leaf about an inch long, which never grew any bigger; and one case is cited where 199½ acres had been plucked, and had given considerably less leaf than had often been obtained from a patch of 17 acres. The only treatment that was tried was extra hoeing in the hope of bringing vigour to the bushes. The report adds—

"To bring the state of things before you in the most comprehensive manner I have pressed some shoots and send them by to-day's post, together with a little bottle containing about 100 of the insects which do, *or are supposed to do*, the damage. They are so active and difficult to catch that it took a boy a day-and-a-half to procure the specimens to send...............On one side of the sheet of paper, on which I have pasted the samples of shoots, you will find healthily grown leaves, ... purposely chosen, rather under than over the average as regards size, so as not to create a false impression, or make the comparison too striking. On the opposite side of the sheet are thrippy shoots of all kinds from the smallest to the largest, but also representing three leaves and the bud. Every one of these should have been as big or bigger than the healthy shoots, but I think the total weight of the sixteen former would not equal that of the three latter. A glance at the specimens will show you how impossible it is to make any outturn out of growth of this kind."

The following account of the blight by Mr. A. W. Madden of Dibrugarh, Assam, was published in the Proceedings of the Agri.-Horticultural Society of Calcutta :—

"Since receipt of your letter of 2nd May, I have been making further enquiries about the blight. I find that a number of gardens are affected by it this season to a much severer extent than in previous years. I enclose a letter from one of my managers.

"At another garden a piece of pure Assam tea, which had been treated in the same way, was first affected, then the blight attacked a piece of tea next it very severely. The latter piece had been pruned into about 4 year old wood, and had new shoots up to a foot long, and many of these have died down completely."

Enclosure.—"I received the Horticultural Society's letter on the 14th instant, which I return. The blight first appears in round white blisters, about the size of a two anna piece, on the under side of the leaf. In a few days these white blisters turn very dark, and expand over the greater part and often the whole of the leaf. When fairly started the darker blight, and not the white blisters, appears to spread over the rest of the bush, sometimes not only attacking the leaves, but the new stem, in which case the stem and leaves above the blighted part double over and eventually fall off.

"All the plots of the garden are now blighted, though in some plots there are only one or two bushes. The plot first blighted, and the surrounding ones, are much the worst.

"In January 1890 the bushes of the blighted plot were pruned down to 9 inches and lower; the prunings were buried in 3 feet trenches which had been cut 24 feet apart. In March it was double hoed, and during the year it was single hoed five times, and in December it was double hoed again. This season it was left unpruned. Since January this year it has been single hoed three times, and last month it was drained by cutting 3 feet drains 48 feet apart, running at right angles to the trenches cut the previous year.

"I forgot to mention that at the time the plot was pruned it was manured by putting one basket of cow manure to four bushes.

"In the first plot I think it is disappearing, but in the surrounding ones it appears to be still spreading. In the letter I sent you this morning I forgot to mention that we have noticed a large number of small green flies about the affected bushes. I send you by post to-day a small bottle containing some of the flies."

According to a report, dated 17th July 1891, kindly furnished by Messrs. Williamson, Magor & Co., of Calcutta, green fly blight had been very prevalent and persistent in its attacks on some gardens in Assam. On one estate open lamps were placed about the tea, but the manager reported that this experiment was a failure, for whereas myriads of other insects were attracted by the flame of the lamps, the green fly remained undisturbed under the tea leaves. The green fly was said to be less numerous and to do less harm in sunny dry weather than when it was wet and comparatively cold, but it seemed to require a good long spell of hot dry weather to cause any appreciable diminution in its ravages. The early part of the present season was unusually wet and cold in Assam, and this is thought to account for the prevalence of the blight.

It may be worth noticing that, in the case of the allied insect which attacks mango blossom, spraying the trees with the arsenical wash which is known as London purple, was tried with some success in the Saharunpur Botanical Gardens. Great care would of course be necessary in applying London purple wash to tea, on account of the poisonous nature of the substance; but in cases when a garden has been shut up by the blight, there would be no danger in trying it, provided no plucking at all

was done until after a new flush had appeared and the bushes had been well washed by rain. The Calcutta Agri.-Horticultural Society has undertaken to have experiments made upon the insect with some London purple that has been sent to the Museum by Messrs. Hemingway & Co., of London and New York, and some of the same insecticide has been furnished to Messrs. Barry & Co. for a similar purpose. The figure shows some of the stages of *Chlorita flavescens*, with much enlarged diagrams of the antenna legs, and terminal segments of abdomen of imago. The size of the insect is indicated by the hair lines

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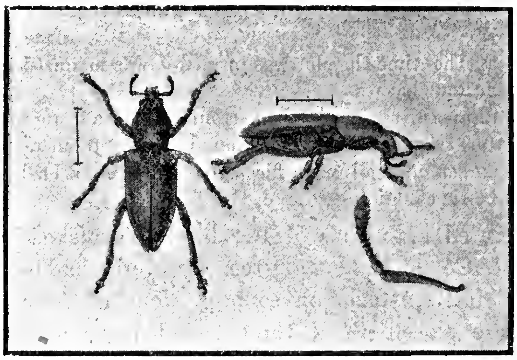
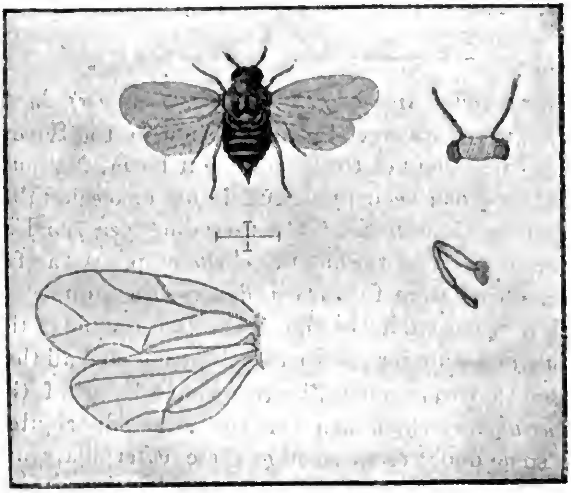
Opium weevil.

In the crop report, for the week ending 23rd December 1891, it is noted that the poppy (*Papaver somniferum*) sowings in Partabgarh (North-Western Provinces) had been attacked and considerably injured by beetles. About the same time numerous mature specimens of a small weevil, which is thought to be the insect referred to in the crop report, were received from Mr. J. Cockburn of Ghazipur. This insect appears to be a species of *Sitones*, but as it is unnamed in the Indian Museum collection, specimens have been sent to Mons. Desbrochers des Loges for favour of determination. In Ghazipur the insect was said to be very prevalent, and an instance was quoted where fields had to be sown three times over on account of the destruction caused by it to the young plants. It was found only to attack the seedlings for the first four or five days of their career, no damage being done after they had once attained a height of half an inch. Flooding the beds was not found effectual in destroying the pest, for the insects crawled on to the partition walls and thus escaped drowning. Hand-picking therefore was suggested by Mr. Cockburn as the most promising means of dealing with the evil. It may be noticed that spraying the young plants with an arsenical insecticide, such as London purple or Paris green, would probably be equally effective and less costly than the hand-picking. The figure shows the imago stage of the insect with much enlarged diagram of the antenna. The size of the insect is indicated by the hair line.

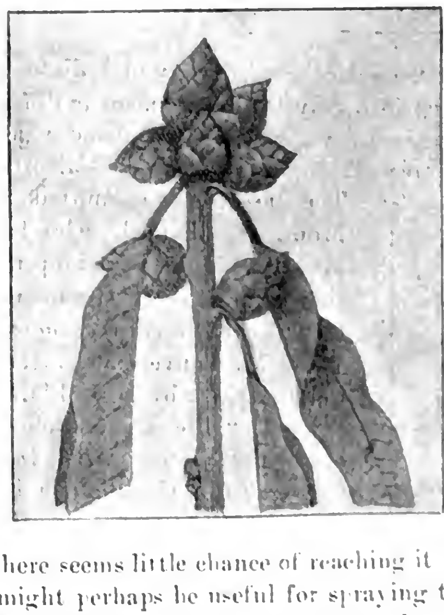


Mango Psylla.

In April 1891 the Director of the Forest School, Dehra Dun, forwarded blighted shoots of mango (*Mangifera indica*), with the information that the whole of the mango trees in a large garden near Dehra were attacked, though, strangely enough, other trees close by had not suffered. The blighted shoots were aborted, so as to appear almost like a series of little green rosebuds upon the twigs. These false buds were found to contain mature *Psyllidæ* (*i.e.*, minute fly-like Rhynchota allied to the Aphidæ). The insect has not previously been described from India, so



it has been sent to Mr G. B. Buckton in England for determination. It is no doubt allied to the *Psylla buxi*, described in the year 1737 by Reaumur, as aborting the leaves of the box tree much in the way that this insect aborts the mango shoots (Reaumur Mem., p.351, pl. 29). With regard to remedies for the pest, any of the kerosine washes which are coming into use in the United States and Europe for destroying plant lice on fruit trees would no doubt also kill this insect, if it could be got at, but the insect is so much protected inside the aborted bud-like shoots that there seems little chance of reaching it with an insecticide. Insecticides might perhaps be useful for spraying the trees when the parent insects are engaged in laying their eggs, but it has still to be ascertained at what time of the year this takes place—whether in the spring or autumn. Clearing up rubbish around the mango trees, where the insects are likely



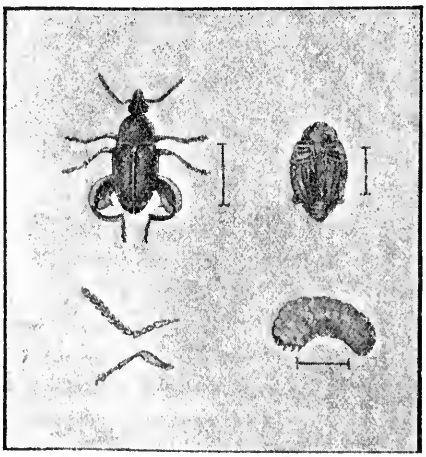
to shelter themselves, picking off and burning the affected shoots, and white-washing the trunks, might also be of some use, but as yet too little is known about the insect to warrant any very definite suggestions for dealing with it. The figures show the winged insect, with much enlarged diagrams of the wings, head and one of the legs, also the end of a mango twig with aborted shoots. The size of the insect is indicated by the hair line.

Linseed caterpillars in Nagpur.

In November 1891 some young linseed (*Linum usitatissimum*) plants were forwarded to the Museum by the Superintendent of the Government Farm, Nagpur, with the information that they had been dying off in an unaccountable manner. A similar blight had been noticed the preceding year, and in some fields had very materially reduced the outturn of the crop. A careful examination of the plants that were forwarded disclosed a number of minute caterpillars which were located in the young shoots at the top of the plants. They were far too immature for precise identification, and all that could be made out was that they were much like very young larvæ of the Noctues moth *Heliothis armigera*, which is a very generally distributed pest in India. There is some doubt as to whether these caterpillars are sufficient to account for the dying off of the plants. The insect could no doubt be easily destroyed by spraying the plants with almost any insectcide, though this is a form of treatment which has not yet been much adopted in India.

Tamarind Bruchid.

From the Secretary to the Agri.-Horticultural Society of India were received (6th July 1891) specimens in different stages of development of a Bruchid which attacks the seed of the Tamarind tree (*Tamarindus indica*) in Calcutta.



The insect was submitted to Mons. A. Fauvel, who has kindly examined it and reports that it belongs to the species *Caryoborus* (*Bruchus*) *gonagra*.[1] Fabr. M. Fauvel calls attention to a paper by H. L. Elditt, entitled "Die metamorphose des *Caryoborus* (*Bruchus*) *gonagra* F." Gratulationschr. der Phys. Œk. Gesellsch. H. Rathke, Königsberg, 1860, dealing with this insect. This paper is not to be found in

[1] This is probably the insect referred to by Dr. H. Cleghorn (Journ. Agri-Hort. Soc., India, Vol. XIV, p. 294, 1867), as infecting tamarind seed.

Calcutta, but an attempt will be made to procure it from Europe. In the meantime it may be noticed that the seeds of almost all leguminous plants are subject to the attack of Bruchidæ beetles belonging to some one of the numerous species of this group of insects. The beetle generally lays its eggs in the immature pod, and the larvæ, which are little white legless grubs, tunnel into the seed where they pass their lives, finally transforming into motionless pupæ from which the beetles emerge ready to copulate and lay eggs of their own.

Postscript —A copy of Elditt's paper has since been procured. Elditt found the insect, in the three stages of larva, pupæ, and imago, in pods of *Cassia fistula* (the Indian Laburnum) which he obtained from apothecaries' shops in Königsberg. After carefully describing the insect in its various stages, Elditt gives an interesting account of the parts of its life history he was able to ascertain. With regard to the egg laying he was not able to make any observations but concluded the insect was likely to have the same habits as the common *Bruchus pisi*. It would therefore lay its eggs in the pods before they reached maturity, and the beetle would be a native of the same country as the tree. Upon the whole he thought that the insect was likely to be a native of the East Indies. He found that the larvæ made its way through the pod and tunnelled directly into the seed; a seed was only big enough to afford nourishment for one grub, and Elditt found that none of the seeds were attacked by more than one grub, though he was unable to explain how this came about. Each seed was enclosed in a chamber with partitions of the shell separating it from the seed on either side of it, and the grub seemed in no case either to have attacked a seed that was already tenanted, or to have tunnelled through the partition walls of the chamber to enable it to pass from a tenanted seed to one as yet unoccupied. When full fed the grub left the seed and spun a close matted cocoon for itself inside the pod. The beetle, after emerging from the pupal skin, rested a considerable time before cutting its way through the cocoon and the wall of the pod, both of which have to be perforated before it can effect its escape. Elditt supposed this period of rest to be a natural feature in the development, serving to give the integument of the beetle time to harden, but it seems more likely that it was a mere accident due to the fall of temperature owing to transporting the insect from a tropical climate into a temperate one. The time passed by the insect in its various stages was not observed. From the paucity of the specimens that he was able to procure, and from the absence of complaint on the subject amongst the druggists he consulted, Elditt concluded that the injury done by the insect to Cassia pods is insignificant. The figure shows the various stages of the insect, also much enlarged diagrams of the antenna and one of the legs of the imago. The size of the creature is indicated by hair lines.

Cut-worms.

Writing from Bahraich, Oudh, on 23rd March 1891, Mr. J. Cockburn notes that he had observed moths of both *Agrotis suffusa* and *Ochropleura flammatra*, which are destructive cut-worms of the rabi and other crops. He noticed them from the 1st November up to the time he wrote, when their numbers were specially great. He added that they had been doing serious damage in the Sultanpore and Bahraich districts, five per cent. of the produce over an area of 9,400 bigas of land in Bahraich being said to have been destroyed by them. From Chupra (Bengal) also specimens of *Ochropleura flammatra* were forwarded in March 1891 to the Museum by Mr. J. A. Bourdillon, with the information that the insect had appeared in immense numbers. In the same month some obscure cut-worm larvæ were forwarded to the Museum by the Manager of the Dighaputya Wards Estate, Rajshahye, with the information that they had been injuring nearly full-grown potato (*Solanum Melongena*) plants. In this case the insect is likely to have been *Agrotis suffusa*, which is known to attack potato plants in India, but the material is insufficient for precise identification.

Tusser Tachinid.

The Bengal silk-worm fly *Trycolyga bombycis* Becher is well known on account of the damage it does in rearing establishments in Bengal where the mulberry silk-worm (*Bombyx sp.*) is cultivated, and attention has recently been called to an allied insect which attacks the Tusser silk insect (*Antheræa mylitta*) very much in the same way. In the collections of the Indian Museum there is a specimen preserved in alcohol of a full grown Tusser caterpillar from Singhboom, which has been attacked by no less than fifteen grubs of the Tusser Tachinid. These grubs are yellowish white in colour, of the ordinary Tachinid shape, with a pair of easily seen mandibles in front and a pair of black stigmata behind. Four individuals were found inside the caterpillar's body, and the remainder had cut their way out through irregular holes that were to be seen in different parts of the skin. Almost the whole of the tissues of the caterpillar had been devoured, no doubt while it was still alive, and the specimen that remains is little more than an empty skin. Many of its stigmata have a dark coloured patch on the inside, no doubt due to the grubs having attached themselves against the stigmata of their host in order to enable their own posterior stigmata to be in connection with the outer air. This somewhat unusual habit has also been recorded in the case of the *Uji* fly (*Udschimyia sericariæ* Rondani) which attacks mulberry silk-worms in Japan, and is a parasite with which the Tusser Tachinid seems to have some affinity. Specimens of the Tusser Tachinid were submitted to Mons. J. M. F. Bigot, who has kindly examined them

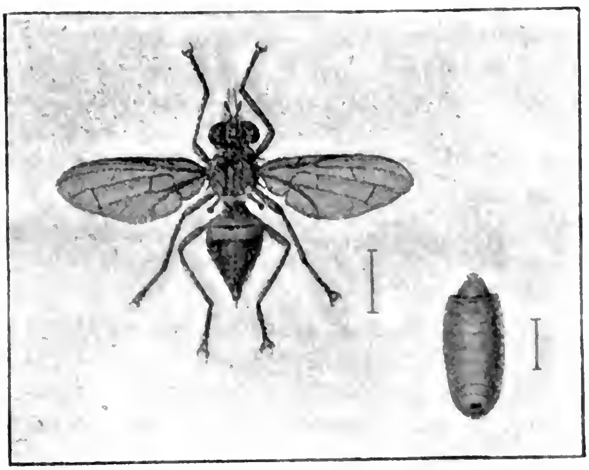
and reports that they belong to the species *Masicera grandis* (= *Tachina grandis* Walker, Ins. Saund. Volume I, page 278, 1856).

An enemy of the rice-sapper.

In October 1891 Mr. J. R. Cripps of Chumparun forwarded specimens of the beetle *Cicindela sexpunctata* Fabr. which was said to devour the *rice-sapper* (*Leptocorisa acuta* Thunb.) and to be very effectual in keeping it in check. The beetles were said to come from the buffalo dung which the cultivators were in the habit of putting into their paddy fields with the express object of rearing the insect in order to keep down the numbers of the destructive *rice-sapper.* It is difficult to see what connection there could be between buffalo dung and Cicindelidæ, but it is worth noticing that a similar idea exists in the Punjab, where the prevalence of the Carabid beetle *Calosoma orientale* Hope, which proved useful in destroying young locusts (*Acridium perigrinum* Oliv.) in the spring of 1891. was attributed in Kohat to the unusual quantity of the fæces of cattle left upon the roads, owing to the large number of transport animals which had recently passed through the district to the Miranzai Expedition.

Mango maggots.

In July 1891 a number of Dipterous larvæ were forwarded to the Museum through the Calcutta Agri.-Horticultural Society, with the information that they had been attacking mangoes (*Mangifera indica*) in Tirhoot. The larvæ were found to be yellowish maggots, about the size of small grains of boiled rice. They had the pointed head and truncated abdomen so common amongst Dipterous larvæ. When liberated from the pulp of the mango they progressed partly by crawling and partly by gathering the



head and posterior together and leaping into the air some four or five inches at a time. A mango in which the grubs were received was placed on a plate of damp earth in the Museum, and the grubs rapidly made their way out and tunnelled into the earth. Here they remained from the 13th

to 22nd of July, when a large number of flies emerged. These flies proved to be identical with a specimen in the Museum collection previously identified by Mons. J. M. F. Bigot as closely allied to the species *Dacus ferrugineus* Fabr., they were therefore provisionally named *Dacus ferrugineus* var. *mangiferæ*. They have since been compared by Mr. O. E. Janson with specimens in the British Museum and identified as belonging to the species *Dacus ferrugineus* Fabr. The insect is no doubt the one reported on page 38 of Volume II of these notes as destructive to mangoes in Mozafferpore. According, however, to the observations of Messrs. Simmons and Blechynden in Calcutta, the insect generally confines itself to over-ripe, injured, and decaying fruit; and it has been suggested that its excessive multiplication in the present case may have been due to previous injury to the mangoes by hail.

The figure shows the imago and pupa, the natural size is indicated by hair lines.

Shorea assamica borers.

In August 1891 a block of *Makai* wood (*Shorea assamica*) was received through the Delhra Dun Forest School, from the Deputy Conservator of Forests, Lakhimpur Division, Assam. It was found to be tunnelled in all directions by Cerambycidæ larvæ. A full grown beetle emerged shortly after the block was received and proved to be closely allied to a specimen in the Museum collection determined by Dr. Lameere as *Neocerambyx holosericeus* (=*Æolesthes holosericeus Gahan*). It differs, however, from this species in possessing a series of spines on the antennæ. A specimen of the Cucujid *Hectarthrum brevifossum* Newm. also emerged in the rearing cage from the same block, and may perhaps prove to be parasitic on the Cerambycid.

Poplar Ægeriid.

With reference to the Baluchistan Poplar Ægeriid (*Sphecia ommatiæformis* Moore), Mr. J. Cleghorn writes in April 1891, that he is now only able to find half-grown caterpillars, and that these are situated between the bark and the wood. This tends to confirm the supposition that the insect's life cycle is an annual one, and that the eggs are laid in the autumn in the bark; the caterpillars would thus have time to get through the bark before the sap mounts in the spring, when they commence tunnelling into the heart of the wood. The percentage of attacked trees was found to be very much smaller in 1891 than in 1890,—a feature which Mr. Cleghorn attributes to the hardness of the winter of 1890-91.

Pinus excelsa Scolytid.

In May 1891 the Conservator of the Forest School Circle forwarded, from his camp near Chakrata in the North-West Himalayas, a log of *Pinus excelsa*

attacked by a bark boring Scolytid. This insect was said to have attacked some trees that had been girdled and were dying. The specimens were submitted to Mr. W. F. H. Blandford who very kindly examined them and determined them as belonging to a species of *Polygraphus* near to the European form *Polygraphus pubescens* Linn. For an account of *P. pubescens*, which Mr. Blandford thinks likely to prove similar in habits to the *Pinus excelsa* insect, see Eichhoff. Eur. Borkenkäfer, page 122, (1881).

Melon seed moth.

In April 1891 some Melon (*Cucurbitaceæ*) seed attacked by the caterpillar of a minute Microlepidopterous insect, was forwarded to the Museum from Peshin, Baluchistan, by Mr. J. Cleghorn. The eggs were thought to have been laid upon the seed in October. Throughout the winter the grubs fed upon the outer portion of the seeds and in April, when the seed is usually taken out to be sown, the caterpillars deserted it and formed their chrysalids on the sides of the bag in which the seed had been stored. The attempt that was made in the Museum to rear the moth for identification was not successful, but the insect is not thought to be of much importance.

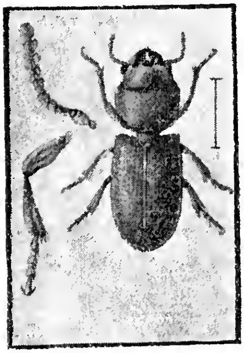
Chir pests.

In July 1891 a number of insects were received through the Director of the Dehra Dun Forest School, from the Officiating Conservator of Forests, Central Circle, North-Western Provinces and Oudh, with information that they had proved destructive to Chir (*Pinus longifolia*) in the Baldhoti plantation.

The specimens were found to comprise four species of Acrididæ (*viz.*, *Chrotogonus sp.*, *Catantops indicus*, *Caloptenus sp.*, and *Œdaleus sp.*), all said to nip off the young plants, also numerous obscure Curculionidæ beetles and earwigs (Euplexoptera) said to be found in dying trees, and probably therefore of but little importance. The Acridid responsible for most of the nipping off of the young *chir* trees is probably the *Chrotogonus*, of which numerous specimens were furnished. This insect is a very common one in many parts of India, and has repeatedly been sent to the Indian Museum as destructive to crops, but no satisfactory method seems to have yet been discovered for dealing with it. The bran and arsenic insecticide, which is said to have been successfully used in the United States against some kinds of Acrididæ, might perhaps be worth trying. It is made by mixing together one part of arsenic, one part of sugar, and six parts of bran, with a little water to form a paste. It should be sprinkled over the plantation for the Acrididæ to eat, the greatest care, however, is necessary in using it on account of the poisonous nature of the arsenic.

Trogositid beetle in Indian wheat.

In a sample of wheat (*Triticum sativum*) from Orissa, which was kept under observation in the Indian Museum during the autumn of 1890, were found numerous small brown beetles (Trogositidæ), which seemed to be associated with the wheat weevil in destroying the grain. Specimens were sent to Mons. Fairmaire, who kindly examined them and reported that they belonged to the species *Trogosita mauritanica* Linn. Mons. Fairmaire adds that this insect has long been known on account of the damage done by its larvæ in wheat granaries. The imago is thought to be carnivorous in its habits, and feeds on the small Tinied moths which are to be found in granaries. The insect is a cosmopolitan one, having no doubt been distributed over the world with grain. The figure shows the imago with much enlarged diagrams of antenna and hind leg. The natural size of the insect is indicated by the hair line.



Crocus caterpillar.

The gaudily coloured caterpillar which have been noticed as defoliating garden plants in Calcutta and Dehra, has recently been reared in the Museum and found to belong to the Noctues moth *Polytela gloriosæ* Fabr. When full fed the caterpillars tunnelled into the ground, where they formed for themselves typical Noctues cells of hardened earth. The first pupæ were formed on 19th July, and the moths began to emerge on the 8th August. The caterpillar may be observed at work throughout the rainy season in Calcutta gardens where it does a good deal of damage to ornamental plants, and as the time spent by the chrysalis in the ground is short, it is probable that the insect passes through a number of generations in the year.

Lasiocampid caterpillars in Burma.

Some hairy caterpillars of a Lasiocampid moth, not previously represented in the Indian Museum collection, were received in November 1891 through Mr. De-Niceville from Rangoon, with the information that the insect had been very destructive. A letter, dated 5th December 1891, upon the subject, was subsequently forwarded from Mr. Noble of the Phayre Museum. In this letter the following report from the Northern Division, Shwebo, Burma, was quoted, but the date of the appearance of the insect was not mentioned :—

"The rain still holds off, and the winds are exceedingly high, unprecedentedly so. The people say—from these high winds blowing the people anticipate a heavy monsoon:

and the circumstance which is said to indicate the approach of plentiful rain is a plague of a species of hairy caterpillar which literally covers the country, destroying the herbage and swarming on the roads to such an extent that thousands of them must be trodden under foot by passing wayfarers. Contact with the hairs produces irritation and even sores. The caterpillar is said to turn into a species of yellow butterfly or moth about August. Burmese name *Pagaungde* or *Rugaungde*."

The specimens have been forwarded to Mr. F. Moore[1] for favour of determination, and further information is awaited from Burma.

Mysore coffee ringer.

Mr. R. H. Morris of Mysore sent (21st April 1891) a series of moths which he has reared from the Mysore *coffee ringer* caterpillars noticed in Volume II, page 7, of these *Notes*. Five of these moths belonged to the species *Agrotis segetum* Schiff., while the sixth was a *Heliothis armigera* Hübn., which is not thought likely to have been connected with the "ringing" of the young coffee plants. Comparing these specimens with the ones noticed on page 7 of Volume II of these *Notes*, we find that out of eight moths reared from caterpillars thought to be the destructive coffee *ringers* of Mysore, six belong to the species *Agrotis segetum*, one to the species *Heliothis armigera*, and one to a species which has been identified through the kind help of Mr. F. Moore as *Orthosia bicornis* Hampson. It may be concluded that *Agrotis segetum* is the insect chiefly concerned in the injury to the coffee (*Coffea arabica*) plants.

With regard to the practicability of poisoning such caterpillars by strewing the ground with succulent cabbage leaves sprinkled with London purple, as has been recommended by the United States Entomologist (*vide* page 33 of Volume I of these *Notes*), some London purple was sent to Mr. Morris for experiment, but he writes that, though it certainly poisons the caterpillars, the cost and difficulty of laying down the poisoned leaves over so large an area as a coffee estate, are prohibitive.

Bamboo Aphid.

In March 1892 specimens were forwarded by the Director of the Forest School, Dehra, of an Aphid which was found attacking the leaves of *Bambusa arundinacea* in the school compound. The insect covered the leaves with a black sticky gum which was in such quantities that it fell off in drops. The insect is unnamed in the Museum collection, and specimens have therefore been forwarded to Europe for comparative examination.

In July 1890 an obscure Geometrid caterpillar, insufficient for precise

[1] The insect has since been identified by Mr. Moore as a new species of *Spalyria*, which he is describing as *Spalyria minor*.

identification, was forwarded by Messrs. Mackinnon, Mackenzie & Co., from Nowgong, Assam, where the insect was said to have been damaging the tea (*Camellia theifera*) bushes. Geometrid caterpillars have not previously been reported as doing any appreciable damage to tea, and the present insect therefore is not expected to be of much importance.

Geometrid caterpillar on tea.

Insects said to infest the *Terminalia belerica* tree in the Thana district, Bombay, were forwarded to the Museum in February 1891 by Mr. F. Gleadow of the Forest Department. The insects were found to be of two kinds—(1) a Bostrychid borer, identical with specimens reported on by Dr. Günther of the British Museum as *Sinoxylon sp.*, and (2) a small Cucujid which has been submitted to Mons. Fairmiare, who has kindly examined it, and reports that it belongs to the species *Læmotmetus insignis* Grouville. The Cucujid is not likely to do much damage, but the Bostrychid is very probably destructive.

Terminalia belerica pests.

Amongst the enemies of wild silk-worms in India may be noticed a large yellow Ichneumonid received from Hazaribagh, where it was said to attack the caterpillars of *Cricula trifenestrata*. The same insect has been bred in the Indian Museum for a caterpillar of the Hesperid butterfly *Telegonus thrax*, also from a cocoon of the wild silk insect *Antheræa roylei*. In the latter case it had destroyed the chrysalis and filled the cocoon with its own pupal cells as shown in plate 9, fig. e, of volume II of these *Notes*. The Indian Museum also contains specimens from Sikkim, bred by the late Mr. Otto Möller, both from the butterfly *Telegonus thrax* and also from the wild silk insect *Antheræa frithii*. The specimens in the Museum collection agree in general markings with the description of *Pimpla punctator*, Linn, as given by Vollenhoven in the Stettin Entomologische Zeitung, volume 40, p. 143, 1879. As however Vollenhoven gives Java, Sumatra, Borneo, Celebes, and China as the habitat of the species, and as the only measurement which he gives of the length of body is 11 millimetres, while the average length of both male and female specimens (excluding the ovipositor) in the Indian Museum collection is 17 millimetres, the specimens being very constant in size, it seems best for the present to look upon the Indian form as a variety. This variety may be provisionally named *Pimpla criculæ*, so as to prevent confusion in the event of its proving distinct from *P. punctator* Linn.[1]

Ichneumonid destructive to wild silk insects.

[1] The specimens have since been submitted to Mr. P. Cameron, who notices (Mem. and Proc. Manchester Lit. and Philos. Soc., 1890-91) that they belong to the special *Pimpla punctator* Linn. a species which he remarks is widely distributed over the oriental region. Mr. Cameron also notices the species *Pimpla zebra* Vollenhoven as bred from *Cricula trifenestrata*.

Determination of miscellaneous pests.

The following miscellaneous pests have been determined for the Museum by Mr. Oliver E. Janson:—

(1) A Dipterous insect said to attack mangoes (*Mangifera indica*) in Lower Bengal. This was compared with specimens in the British Museum and identified as *Dacus ferrugineus* Fabr.

(2) Cantharidæ said to damage crops of yellow cholum (*? Sorghum vulgare*) in Madras. These were compared with specimens named by Dr. Haaq, and identified as belonging to the two species *Epicauta rouxi* Cast. and *Epicauta tenuicolli* Pall.

(3) Tenebrionidæ said to attack young linseed (*Linum usitatissimum*) and wheat (*Triticum sativum*) plants in Katwa, Bengal, determined as *Opatrum depressum* Fabr.[1]

(4) Dermestidæ destructive to stored wheat (*Triticum sativum*) in the Delhi bazaar, identified as *Æthriostoma undulata* Motsch.

(5) Bostrychidæ said to have been found boring into the stem of a guava tree (*Psidium Guava*) in Hazaribagh, identified as *Bostrychus sp.*, *Sinoxylon sp.*, and *Cænophrada anobioides* Waterhouse. The last species was identified after comparison with the type specimens.

(6) Curculionidæ reported as destructive to Hibiscus plants in Durbhunga, identified after comparison with the original type specimen, as *Desmidophorus hebes* Fabr.

(7) Curculionidæ reported as destructive to garden plants in Durbhunga, identified as *Astycus lateralis* Fabr.

(8) White-ants forwarded from Balasore in December 1888, compared with the original type specimen and identified as *Termes taprobanes* Walker.

In the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 1890-91, Mr. P. Cameron describes and figures the following insects which he has been so kind as to examine. It is hoped that the insects will shortly be returned so that the type specimens may be preserved in the collections of the Museum :—

(1) *Platygaster oryzæ* n. sp. (plate 1, figs. 6 and 8) bred by Mr. Wood-Mason from *Cecidomyia oryzæ* W. M., a midge said to have proved destructive to paddy (*Oryza sativa*) in Monghyr in October 1880.

[1] The species *Opatrum micans* is recorded as injurious to crops by Miss Ormerod. (Injurious Insects of South Africa, p. 19).

(2) *Aphelinus theæ* n. sp. (plate I, figs. 5 and 5*a*) bred by Mr. F. W. H. Miles from the tea scale insect *Chionaspis theæ* Maskell.

(3) *Pteromalus oryzæ* n. sp. (plate I, figs. 2 and 2*a*), believed to be parasitic on the rice weevil *Calandra oryzæ* Linn.

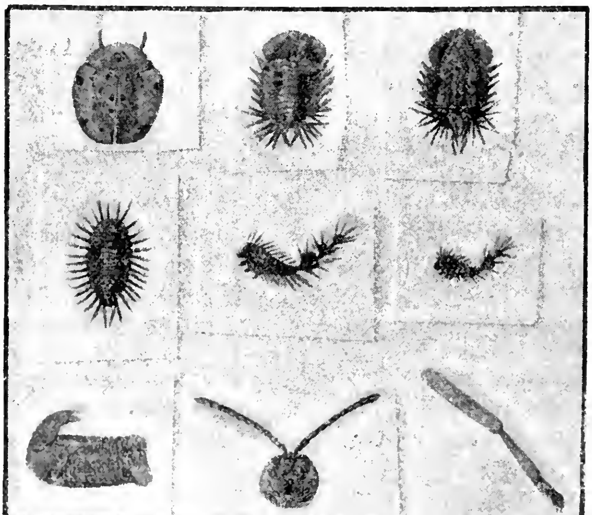
(4) *Cotesia flavipes* n. sp. (plate I, figs. 3 and 3*a*) bred in the Museum from caterpillars of the destructive sorghum borer *Diatræa sp.* received from Poona.

Stromatium barbatum.

Specimens of the Cerambycid beetle *Stomatium barbatum*, Fabr., were forwarded to the Museum in June 1891 by the Director of the Forest School, Dehra, with the information that they had been damaging wood specimens in the School Museum. A block of khair wood (*Acacia Catechu*) that was forwarded with the beetles was found to have the whole of the sap wood riddled with tunnels made by the larvæ. These tunnels were tightly packed with the powdered wood that had been eaten out and probably passed through the digestive organs of the grub. The hard heart wood was untouched.

Aspidomorpha militaris.

The Cassid *Aspidomorpha militaris* Fabr., has been reared in the Museum upon convolvulus (*Convolvulaceæ*) leaves. Young larvæ received on 7th July became adult on 29th of the same month, by 20th September these imagos had laid a large number of egg capsules, which produced young larvæ. In the rains in Calcutta, therefore, this insect takes little over two months to complete the cycle of its existence. The egg capsules are large oblong agglutinated masses, sometimes more than half an inch in length. The larvæ are the little spined creatures shown in



the figure. They shed their skins at intervals, the cast skins remaining

attached to the spines at the posterior of the abdomen. In the pupa, see figure, these cast skins are dropped. The insect is not known at present to do any damage to crop in India, but it is one of those common species which are always liable to multiply to such an extent as to prove destructive as defoliators. The figure shows the imago dorsal view, the pupa dorsal and ventral view, three stages of the larva, and egg capsule, all natural size, also front view of the head and one of the legs both much enlarged.

Stored pulse pest.

Attention was called in December 1891 to damage done to Arhar pulse (*Cajanus indicus*), stored in Calcutta, by *Bruchus chinensis* Linn. This insect is the common *gram weevil* of Lower Bengal, and is often very troublesome.

Gall-nut tree defoliator.

In March 1891 specimens of an insect, said to injure *gall-nut* trees (*? Teminalia Chebula*) on the Kambakkan hills, were sent to the Indian Museum, through the Dehra Forest School, by the District Forest Officer, Chingleput, Madras. The specimens proved to be little cone-shaped larval case of a Psychid moth. They were a little larger in size but otherwise indistinguishable from the larval cases of the species *Babula grotei* Moore, a species which often defoliates ornamental shrubs in Calcutta gardens.

Scale insects on tea.

In December 1891 information was received through Messrs. Mitchell, Reid & Co., of the presence in small numbers of the Coccid *Chionaspis theæ* Maskell (=*Aspidiotus theæ* green MS.) on tea (*Camellia Thea*) in the Kangra valley. The curious little fluted scales of the male insect of this species were represented in considerable numbers upon the leaves that were sent to the Museum for examination. No particular harm seems to have been done as yet by this insect, but it is one to be watched carefully as it has now established itself upon tea both in the Himalayas and in Ceylon, and may at any time prove destructive. It is satisfactory to learn that the kerosine and soap emulsion which have been recommended for use against this insect have been used successfully in the Kangra valley.

Apis dorsata.

According to a note furnished by Mr. J. Sinclair, the large jungle bee *Apis dorsata* is more abundant on rocks at from 2,000 to 3,000 feet elevation, under the 19th, 20th, and 21st degrees N. Latitude, in the Ghâts, Deccan, and Konkan, than in any other position in that region. It is, however, found in old buildings (and sometimes in new ones), upon large trees and

in other suitable positions pretty commonly throughout the Regulation Districts of Bombay from sea-level upwards. On the upper Ghâts (as at Mahableshwar), it perforce confines itself to rocks and buildings, for big trees where it can build its nest in safety are scarce.

Red spider.

A note written some years ago by Mr. M. H. Clifford, late of the Forest Department, has recently been found amongst some old papers in Dehra. According to this note native hakims extract a kind of oil from the large velvety red mites (*Tetranychus sp.*), commonly known as *red spiders or Birbhoti* in the North-West Provinces. The oil is sold for medicinal purposes at a high price, and even the insects themselves fetch as much as a rupee per tola. It will be interesting to learn if anything further is known of the medicinal virtues attributed to this mite.

Insect pests in Baroda.

Mr. T. H. Middleton of the Baroda College, writing in August 1891, notices a good deal of damage to sugar-cane (*Saccharum officinarum*) on the Baroda College farm by an insect which is known locally as *Narkote,* and which, from the description, appears to be the well known sugarcane borer *Diatræa saccharalis.* He also notices a voracious hairy caterpillar from an inch to an inch-and-a-quarter in length, and red, brown, or nearly black in colour, which appears after the first fall of rain, and is very abundant for about three weeks, after which it disappears as suddenly as it came. It chiefly attacks young plants, and plants growing along the surface of the ground. It is known by the natives as *Katra,* and is no doubt the larvæ of one of the Bombyces moths, many of which are injurious defoliators.

Insect pests in Hooghly.

In August 1890 specimens of paddy (*Oryza sativa*) injured by insects were forwarded to the Museum, through the Director of Land Records and Agriculture, Bengal, from the Collector of Hooghly. With the paddy stalks were found specimens of the two Chrysomelid beetles *Hispa ænescens* Baly and *Aulacophora abdominalis* Fabr. The damage is likely to have been chiefly due to the first of these insects, which is a well known rice pest in Lower Bengal.

Insect pests in South Arcot.

Specimens have been received, through the Central Museum, Madras, of some insects said to have proved injurious to *chambu* (*Pencillaria spicata*) and *cholum* (*Sorghum vulgare*) in the South Arcot District in December 1891. The insects prove to belong to two species, the first of these is *Nezara*

viridula Linn.—a cosmopolitan Pentatomid which has previously been sent to the Museum as occurring on potato (*Solanum tuberosum*) halms in Bangalore. The second is a small Capsid, which is as yet unnamed in the Museum collection. Specimens are being sent to Europe for precise identification.[1]

Tusser in the Punjab.

In a paper published in the Journal of the Agri.-Horticultural Society, Calcutta, Vol. VIII, 1890, Mr. W. Coldstream gives further particulars of his attempts to cultivate Tusser silk worms (*Antheræa mylitta*) in the Punjab. The experiments were chiefly conducted in Hoshiarpur and Lahore, and they extended through several years. The outturn of cocoons seems to have been very unsatisfactory, but as the result of his experiments, Mr. Coldstream concludes that the cultivation of the Tusser silk worm, as a cottage industry, is by no means impossible in the submontane districts of Northern India where the *Zizyphus jujuba* tree flourishes.

Pœcilocera picta.

In July 1890 a specimen of the Acridid *Pœcilocera picta* Fabr. was furnished, through the Director of Land Records and Agriculture, Bombay, from the Assistant Political Agent, Jhalawa, Kathiawar. The insect was known locally as *Khapedi*. It was said to breed in June, July, and August and to damage the young crops. *Khapedi* seems to be the general local name for Acridid grasshoppers of all kinds, and *Pœcilocera picta* Fabr. is likely to be only one of a number of Acrididæ of local origin which proved injurious to young kharif crops in Kathiawar and Sind in the rainy season of 1890.

Epacromia dorsalis in Sind.

In the early part of September 1892 numerous specimens of the Acridid *Epacromia dorsalis* Thunb., were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Bombay, with the information that they had been attacking young kharif crops in the Upper Sind Frontier district. According to a report subsequently furnished by the Deputy Collector of this district, the young jowari (*Sorghum vulgare*) crop over an area of 570 acres was destroyed by this insect in the early part of the kharif season of 1891. The Deputy Commissioner adds—"these insects appear generally on the lands situated in the vicinity of the hills stretching along the northern bank of the Desert Canal, and cause considerable damage to germs of kharif crops while the sowing operations are still in progress."

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[1] Mons. Lethierry has since examined this insect. He determines it as a new species of *Calocoris* which he is describing under the name of *Calocoris angustatus*.

Acrididæ attacking tea.

In February 1892 information was received through Messrs. Jardine, Skinner & Co., of considerable injury to young tea (*Camellia theifera*) bushes in the Western Doars by Acrididæ. Of the insects forwarded to the Agents, some were identical with specimens in the Museum collection determined by Dr. De Saussure as his *Catantops indicus*, while others seemed to be a variety of the same species, characterized by the absence of striped markings on the posterior femora.

Two specimens of the species *Acridium flavicorne* Fabr. were afterwards forwarded as associated with the insect first reported. In the end of February the Manager wrote that he had been to a great extent successful in destroying the insects, and that he had not heard of their appearing on any of the neighbouring gardens. The method adopted was hand-collecting by children and coolies, who were paid two annas per hundred insects. Up to the date of his letter, the Manager estimated that he had destroyed 31,770 insects in this way, with the result that they were getting so much scarcer that, at the time he wrote, the coolies were only bringing in about 25 per cent. of the daily number they had been able to obtain when hand-collecting was first started.

Acrididæ in Vizagapatam and Cuddapah.

Specimens of the Acridid *Acridium æruginosum* Burmeister were forwarded, in the early part of August 1891, through the Madras Museum, from the Collectorate of Vizagapatam and also from that of Cuddapah for identification. In the case of the specimens from Vizagapatam the females were found to have their ovaries crammed with ripe eggs. *Acridium æruginosum*, therefore, is likely to have been the insect referred to by the Collector of Vizagapatam, who wrote on 18th July that a flight of locusts had recently visited the Royaghada taluk in his district and caused slight damage to the standing crops. He noticed that these locusts appeared to have laid eggs which had hatched. The winged insects had disappeared, but the young locusts were still to be found on the hills at the time the report was made.

Acridium æruginosum is one of the six local species of Acrididæ which have been reported as concerned in the Madras locust invasion of 1878. The flight of locusts, therefore, which visited the Vizagapatam District in July 1891 must not be confused with the flights which had previously invaded the whole of the Madras Presidency, and which consisted of insects belonging to the very different species *Acridium peregrinum* Oliv. which had made its way across India from the North-West Frontier.

Unfortunately no record is forthcoming of the part played by the six local species of Acrididæ which were reported in connection with the

Madras locust invasion of 1878, but it may be worth noticing that in the set of specimens that reached the Indian Museum, as responsible for the damage that was done in 1878, *Acridium æruginosum* was represented by more specimens than any of the other species, so it may perhaps have been the insect referred to by the writers of most of the reports, who seem to have noticed but one kind of insect.

Acridiidæ in Gangam.

In November 1891 a number of Acridiidæ were forwarded as the locusts which had lately appeared in the Chicacole Taluk of the Ganjam Collectorate. The specimens proved to belong to no less than six very distinct species of grasshoppers. The following is a list of them:

(1) *Hieroglyphus furcifer* Sauss. (seven specimens of which five were immature), (2) *Oxya velox* Burm. (two immature specimens), (3) *Acrida turrita* Linn. (two mature specimens), (4) *Euprepocnemis bramina* Sauss. (two mature specimens), (5) *Atractomorpha crenulata* Fabr. (one mature specimen), (6) *Epacromia, dorsalis* Thunb. (one mature specimen). These species are all likely to attack plants and may perhaps do some damage to crops over restricted areas, but none of them are known to occasion any such widespread injury as that which is often done by migratory locusts.

Acridiidæ in Meywar.

In April 1891 a number of Acridiidæ collected in Meywar were forwarded to the Museum, through the Government of India, from the Agent to the Governor-General in Rajputana. They were thought to have been associated with the locust invasion of Meywar, but it is more probable that they were merely representatives of local species of Acridiidæ that were to be found after the flights of the true locust (*Acridium peregrinum* Oliv.) had passed away. The insects have been compared with the specimens in the Museum collection named by Dr. De Saussure, and have been identified as follows: ten specimens of *Catantops indicus* Sauss., four specimens of *Chrotogonus trachypterus* Blanch., one specimen *Epacromia dorsalis* Thunb., and three specimens doubtfully identified as *Trilophidia annulata* Thunb.

Acridiidæ in Godavari.

A number of specimens of the large green Acridiid *Pœcilocera picta* Fabr. were forwarded to the Indian Museum in October 1891 from the Godavari District. Details of the damage done by this insect have not yet been procured.

Acrididæ in Howrah.

In September 1890 some Acrididæ, known locally as *Kat foring*, were forwarded, through the Director of Land Records and Agriculture, Bengal, from the Deputy Collector of Howrah, with the information that they had been damaging the immature ears of paddy (*Oryza sativa*). The insects were found to comprise a single individual of the species *Catantops axillaris* Sauss., and seven specimens of a species of *Euprepocnemis* unnamed in the Museum collection.

Grasshoppers associated with locusts in Kohat.

The following Locustidæ and Acrididæ were forwarded in June 1891 by Captain G. C. Parsons, Deputy Commissioner of Kohat. They were found associated with the destructive locust *Acridium peregrinum* Oliv. in Kohat, but this association is thought likely to have been accidental only. It may be useful, however, to record the species that were prevalent at the time that the locusts appeared. The species sent to the Museum were as follows:—(1) A species of *Mecapoda* (Locustidæ) male and female. (2) *Acridium melanocorne* Serv. (Acrididæ), khaki coloured insect with no very definite wing markings. (3) *Acridium æruginosum* Burm., with stripes on the back and sides of the prothorax. (4) Small grasshoppers which have been determined as *Epacromia dorsalis* Thunb., *Euprepocnemis bramina* ? Sauss., and *Sphingonotus sp.*

The Rosy pastor *versus* locusts.

A very interesting series of reports on the subject of the destruction caused amongst locusts of the species *Acridium peregrinum* Oliv. in the Punjab, by the Rosy pastor (*Pastor roseus* Linn.), which is known as the *Sauch, Tilia,* or *Jowari* bird, have been furnished by the Secretary to the Government of India in the Revenue and Agricultural Department. Reports also that have been furnished through the Director of Land Records and Agriculture in Bombay show that the same bird has long been noticed as very effectual in destroying locusts in Sind. The species to which the bird belongs has been determined by Mr. W. L. Sclater from specimens received from Bannu, Kohat, and Gujranwala, forwarded to the Museum by the Director of Land Records and Agriculture, Punjab, through whom also most of the reports have been procured. In view of the great effect which the bird undoubtedly has in keeping the locusts in check, it has been suggested in several quarters that it might be a good thing to take measures to have it protected by legislation. It seems very doubtful, however, to what extent any such measures would be useful in the end, in view of the great injury which the bird is said to do to grain crops in India.

The following account of *Pastor roseus*, Linn (the rose-coloured Star-

ling or Rosy pastor) is taken from Jerdon's *Birds of India*, Volume II, page 333 :—

"It usually makes its appearance in the Deccan and Carnatic about November, associating in vast flocks, and committing great devastations on the grain fields, more specially on those of the cholum or jowaree (*Andropogon sorghus*), whence its familiar name in the south. Mr. Elliot, in his manuscript notes quoted in my catalogue, says: 'Is very voracious and injurious to the crops of white jowaree,' in the fields of which the farmer is obliged to station numerous watchers, who, with slings and a long rope or thong, which they crack dexterously, making a loud report, endeavour to drive the depredators away. The moment the sun appears above the horizon they are on the wing, and at the same instant shouts, cries, and the cracking of the long whips resound from every side. The Tilliaers, however, are so active that if they are able to alight on the stalks for an instant, they can pick out several grains. About 9 or 10 o'clock A.M. the exertions of the watchmen cease, and the Tilliaers do not renew their plundering till evening. After sunset they are seen in flocks of many thousands retiring to the trees and jungles for the night. They prefer the half-ripe jowaree, whilst the farinaceous matter is still soft and milky. When they can no longer get grain, they feed on various grass and other seeds, flower-buds, fruit, and also on insects, seeking them on the ground, but they are rarely seen with cattle in India. The Telugu name is derived from the name of a plant whose fruit they are particularly fond of. Mr. Blyth remarks that 'they visit the neighbourhood of Calcutta only at the end of the cool season, when flocks of them are not unfrequently observed upon the arboreal cotton tree then in bloom.'

"Burgess states that he has seen them busily feeding on the flowers of the leafless caper, a shrub very common in the Deccan, on the banks of the larger rivers. Dr. Adams says that 'it is very abundant in the Punjab, committing great havoc on the grain there.' In the north-west of India, and in Afghanistan, they devour large quantities of mulberries in spring, hence called the '*Mulberry-bird*' in the north-west, disappearing afterwards. They at times, however, feed much on insects, and are called the 'locust-eater' in Persia, according to Chesney. They do not breed in this country, quitting the south of India in March, but lingering in the north a month or so longer. It is ascertained that they breed in vast numbers in Syria and other parts of Western Asia, in rocky cliffs. Burgess states his belief that they breed in India somewhere, and was informed by a native that they do breed in the Ghâts. This however is, doubtless, totally without foundation. Mr. Layard states that one year he saw large flocks of these birds in July, that they remained only a week, and then disappeared. They were entirely unknown to the Natives. Burgess also states that in 1850, towards the end of August, he saw a large flock of the rose-coloured starlings feeding on insects in an open field. These instances of their appearing so early are very unusual, and more especially their occurrence in Ceylon in July, by which time the young could only have been just fairly fledged."

Mr. M. F. O'Dwyer, Settlement Collector of Gujranwala, quotes an interesting Hindoo legend, to the effect that in response to the prayers of the people, the locusts have been imprisoned in a deep valley, surrounded by impenetrable mountains in the west of the Himalayas. The exits from this valley are guarded by *Tilliars* (rosy pastors), commissioned by heaven for the purpose. Now and then, when the sentinels fail in their duty of watch and ward, the locusts escape and are hotly pursued by the

Tilliars, who, unable to drive them back to their prison in the hills, slay them wholesale.

The origin of this legend is supposed to be the fact that the locusts and *Tilliars* generally arrive in Gujranwala from the direction of the hills at about the same time in the spring. It has been noticed also that when the locusts enter a grain field the *Tilliars* do not pursue them into it, but station themselves all round its borders and kill the locusts as they issue forth.

The following are abstracts of the information that has been received upon the subject of this bird :—

The locusts in parts of Sind in 1889-90 were reported to have been exterminated by *jowari* birds, which did not attempt to eat the locusts, but snipped them in two and left them. In Khandesh also, in 1883, the jowari bird or rose pastor was mentioned by Mr. Ommanney as a great enemy of the locusts.[1] (Annual Report, Director of Land Records and Agriculture, Bombay, 1889-90).

In the *Civil and Military Gazette* of 24th July 1891 it is reported that a bird known by the Afghans as *Sanch* has appeared in vast numbers in the provinces of Jellalabad and Lataband, and done much good in destroying locusts.

Major H. P. Leigh, Deputy Commissioner, Kohat, writes (27th August 1891), that all the natives he has questioned agree in describing the *Sanch* bird, said to have appeared in such large numbers in Afghanistan, as a *Tiliar* (starling or rosy pastor). This bird appears in Kohat in large numbers, mixed up with large flocks of Kabul sparrows, when the mulberries are ripe, and migrates down country, re-appearing in the autumn on its way north. The flocks chatter tremendously and dash from tree to tree, but have not been noticed on the ground. The bird is known in Kohat as *Kangira*, and it preys on the locust, though curiously enough it has been almost a stranger in Kohat during the past year, perhaps because it found such abundant food among the locust swarms in Afghanistan and adjacent countries. It is said that the *Kangira* if in small numbers, will not face a dense flight of locusts.

In a letter, dated 29th August 1891, Major H. P. Leigh, Deputy Commissioner, Kohat, recorded the alleged destruction of a flight of locusts by the rosy pastor. Specimens of the bird were at the same time forwarded to the Indian Museum and identified by Mr. W. L. Sclater. The Tehsildar, who was sent from Kohat to arrange for the destruction of some locusts which has appeared in the neighbourhood, reported that the swarm had been destroyed by the starling. He watched them for some time, and noticed that, after killing a dozen or so of insects, the bird would fly off to water, cleanse its bill, and begin again, appearing rather to kill the locusts for amusement than for food, as it left them in the most mutilated condition.

The Deputy Commissioner, Dera Ghazi Khan, wrote (26th August 1891) that the common *Tilliar* or starling (rosy pastor) eats locusts greedily. On one occasion in July, when flights of locusts invaded the station of Dera Ghazi Khan, the *Tilliars* were said to have flown out in a swarm to meet them and attacked them fiercely. The locusts tried to avoid them but did not succeed in doing so, and were beaten off. The damage done in the station was consequently very slight. The *Tilliars* are most numerous in Dera Ghazi Khan from about the middle of July to the end of August.

[1] The locusts referred to by Mr. Ommanney probably belonged to the species *Acridium succinctum* Linn., which invaded the whole of the Bombay, Deccan and Konkan in the years 1882-83.

Specimens of the Rosy pastor (*Pastor roseus*) were forwarded (8th September 1891) by Dr. F. Chand, Civil Surgeon, Gujranwala, as very effectual in destroying locusts.

The Deputy Commissioner, Dera Ismail Khan, wrote (1st September 1891) that *Sanch* is believed to be the Yusafzai-Pashtu for a starling known as *Tilliar* in Hindi and *Sirokka* in Pashtu. He noted that the bird eats, or rather destroys, locusts in a most voracious manner.

On 7th October 1891 specimens of the *Sanch* bird, said to have destroyed a large number of locusts in the Bannu district, were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Punjab. They were identified by Mr. W. L. Sclater as belonging to the species *Pastor roseus* Linn. (Rosy pastor).

The Acting Deputy Commissioner of Thar and Parkar, Sind, reports (21st December 1891) that the *jowari* birds have very materially assisted in clearing the district of locusts.

The Deputy Commissioner, Lahore, notices that the Naib Muhafiz Daftar of Peshawar, informs him that *Sanch* is the Pathan name for the bird known in Lahore as *Tilliar* (Rosy pastor).

Tachinid locust parasite.

A tachinid parasite has been discovered which attacks the winged form of the locust *Acridium peregrinum* Oliv. In June 1891 it was reported that the locusts in Sind were dying in large numbers from the attack of this parasite, and there is evidence also to show that it was to be found amongst locusts in other places. The attempts that have been made in the Indian Museum to rear the parasite have not as yet been very successful, and the paucity of the specimens that have been sent to the Museum tends to show that the parasite is scarcer than has been supposed. In any case, however, the occurrence of a parasite which must necessarily cause the death of every locust it attacks, is of interest, as the species may at any time increase so as to become a most effectual check upon the multiplication of the locusts, and in this case it would be a very valuable ally as it attacks the winged locusts, which are just the ones that are most difficult to deal with by artificial methods. The habits of the parasite have only been partially traced as yet, but what has been observed corresponds so closely with the habits that obtain amongst other members of the same group of insects that we may safely infer the remainder.

The parasite is a two-winged fly, not unlike a very large house fly. It is related to the *Trycolyga bombycis* Becher, which attacks silk worms in Bengal. Like other Tachinids it no doubt deposits its eggs upon the locust's body, and the grubs that have been found attached to the muscles in the thoracic cavity of the locust are no doubt the ones that have hatched out from these eggs and tunnelled their way through the tissues. The grubs that have been found are white legless larvæ about the size of large grains of boiled rice. They have their anterior end pointed and armed with a pair of sharp mandibles. When full-grown they no doubt cut their way out of the locust's body and make their way into the ground, where they transform into little brown bean-shaped pupæ, and in this state they lie until the bean-shaped pupal case splits and the fly emerges ready to seek a mate and to lay eggs of its own.

The following notes show how the question now stands—

On dissecting a specimen of the locust *Acridium peregrinum* Oliv. taken by Dr. L. A. Waddell in the Red Sea on 29th August 1890, grubs of a Tachinid parasite were found embedded in the tissues of the thorax.

One of the specimens of *Acridium peregrinum* taken from a flight which appeared on 27th May 1891 in Gohilwad Prant, Kathiawar (forwarded by the Assistant Political Agent, Gohilwad Prant), was found to have two similar grubs embedded in its thorax.

On the 26th June 1891 the Deputy Commissioner of the Upper Sind Frontier District noticed that the locusts were dying in large numbers from the effect of a grub. Numerous specimens of *Acridium peregrinum* were forwarded in alcohol, and from these two similar Tachinid grubs were obtained. One of these grubs was found loose in the alcohol in which the locusts were preserved, and the second was dissected out of the thoracic cavity of one of the locusts, where it was found attached to the muscles. Careful dissection of all the other specimens that were forwarded failed to reveal any more grubs.

On 27th August 1891 Mr. C. F. Elliot of the Forest Department in Baluchistan forwarded specimens of *Acridium peregrinum* infested by similar grubs which he noticed were very prevalent amongst the locusts then to be found in his neighbourhood.

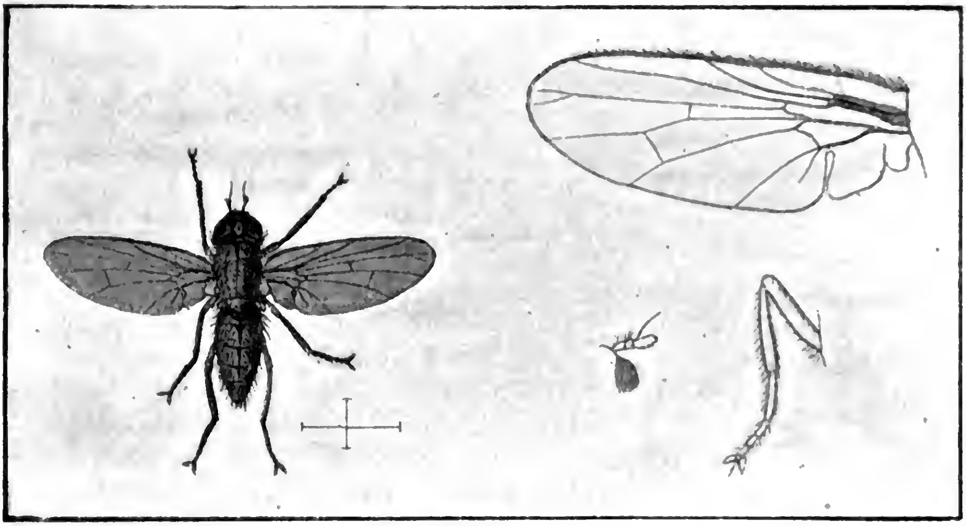
On 29th August 1891 Major H. P. Leigh, Deputy Commissioner of Kohat, forwarded numerous specimens of *Acridium peregrinum* said to be infested by the parasite. From these a single specimen of the fly was obtained, but so much damaged as to be unsuited for precise determination.

On 7th October 1891 further specimens of the same locust, said to be attacked by the parasite, were forwarded by C. E. S. Steel, Esq., Deputy Commissioner, Upper Sind Frontier, Sind, but specimens of the mature insect were not obtained.

Locust egg parasite.

In the early part of April 1891 a vast number of small Dipterous insects, much like diminutive house flies, were reared in the Museum from a set of *Acridium peregrinum* Oliv. eggs received from Peshawar. The flies emerged in great number from the egg masses, and as each fly was probably responsible for the destruction of at least one locust egg, the effect of the parasite in reducing the numbers of the locusts must be very appreciable. Specimens of the fly were sent to Mons. J. M. F. Bigot, who identified them as belonging to a new species of *Anthomyia*, which he proposes to name *Anthomyia peshawarensis*. It may be noticed that an allied species (*Anthomyia angustifrons*) has been found to attack the eggs of the Rocky mountain locust (*Caloptenus spretus*) in America; Dr. Riley, the United States Entomologist, indeed estimates that as much as 10 per cent. of the eggs laid by the Rocky mountain locust are destroyed by it.

The precise life history of the Indian species is not yet known, but it is probably similar to that of its American relation, which, according to Dr.



Riley, deposits its own minute eggs in the ground close to where the locust has previously laid its eggs. Minute maggots rapidly hatch out from the fly's eggs, and bore their way into the egg mass of the locust where they feed upon the contents of the locusts' eggs, and finally transform into little brown pupæ, from which the flies emerge ready to lay more eggs, and thus repeat the cycle of their existence. The figure shows the image of *Anthomyia peshawarensis* Bigot, with much enlarged diagrams of wing, antenna and leg. The natural size of the image is indicated by the hair line.

An enemy of the young locust.

In May 1891 Mr. W. R. H. Merk, Deputy Commissioner, Peshawar, forwarded specimens of Carabid beetle which has been identified as *Calosoma orientale* of Hope. This insect was said to have been observed in vast number in the Peshawar district feeding voraciously upon the young unfledged locusts. The locust referred to is *Acridium peregrinum* Oliv. which has been doing so much damage in Northern India during the last few years. In a report, dated 19th June 1891, forwarded to the Museum by the Commissioner of Peshawar, Captain C. G. Parsons, writes:—

" A black beetle, probably of the kind Mr. Merk sent a specimen of to Calcutta

attacked them with avidity. These beetles seem to be bred out of the fæces of the cattle, from which nest they appear in great numbers after the dropping is a day or two old. The large numbers of transport animals which have recently passed through the district to the Miranzai Expedition have caused the origin of large quantities of these beetles, and they were the locusts' most determined foe."

The figure shows the beetle natural size.

Fungoid locust disease.

In the Comptes Rendus des Séances de la Société de Biologie, Paris, 9th January 1892, Mons. A. Giard gives some account of a fungoid parasite *Lachnidium acridiorum*, which has been found attacking the locust *Acridium* (*Schistocerca*) *peregrinum* Oliv. in Algeria. Mons. Giard writes that this fungus does so little harm to the locusts that it is quite useless to expect any practical result from attempts to spread the disease by artificial means. This conclusion is of interest in view of the suggestions that have been made on the subject of disseminating disease by artificial methods amongst the hordes of the same locust in India.

Troad locust parasites for India.

A suggestion has been made that it might be worth while to attempt the introduction into India of a beetle said to have been discovered by Sir John Lubbock in the Troad, when it was supposed to have been very effectual in keeping down locusts by destroying their eggs.

The insect referred to is no doubt the parasite exhibited by Sir John Lubbock at a meeting of the Entomological Society of London held on 3rd November 1880. This parasite was at first supposed to be the larva of a Cantharid beetle, but afterwards proved (see Proc. Ent. Soc. London, 1881, page xv) to be the larva of a two-winged fly, which seems to have very similar habits to those of the *Anthomyia peshwarensis* Bigot, noticed on page. 34. *Anthomyia peshwarensis* already exists in vast numbers in India, so the place proposed to be filled by the introduction of the Troad species is already at least partly occupied; besides this, however, if the Troad species were able to attack the Indian locust (*Acridium peregrinum*), it would, in all likelihood, have already found its way to India, for there is no geographical obstacle of sufficient magnitude to prevent the spreading of such an insect as the Troad locust fly from the Troad to the Punjab The locust, indeed, for whose destruction it has been proposed to introduce the parasite, already ranges over most of the intervening countries, and thus offers every facility for the purpose.

Locusts in Kohat.

During the past year a very large number of reports, many of them illustrated by specimens, have been forwarded to the Indian Museum from all parts of India, in connection with the locusts which have been so widely prevalent. With a few unimportant exceptions, these locusts have all belonged to the species *Acridium peregrinum* Oliv., which is the chief migratory locust of the whole of Northern Africa and South-Eastern Asia. In the early part of 1891 a detailed report was issued, in which the information collected on the subject of this insect was brought down to the 1st December 1890. The present number of the *Notes* contains what has since been ascertained on the subject of its prevalence in Northern Africa, Persia, and Turkish Arabia, also on the subject of the parasites, disease, and other natural enemies that attack it. The reports relating to its presence in India are so numerous that they will take some time to arrange. In the meanwhile we take the liberty to quote the following from Captain C. G. Parson's interesting account of the invasion of the Kohat district, as it is very typical of what occurred elsewhere. This report is dated 19th June 1891. It was forwarded to the Museum by the Commissioner and Superintendent of the Peshawar Division:—

"There has been immense opportunity for observing locusts in the Kohat district for about the middle of April the plains of the Kohat Tahsil became alive with young ones of the Peregrinum species which marched down from egg-beds which principally lay beyond the border in the lower part of the hills. Great efforts were made to drive these larvæ into trenches, and enormous numbers were destroyed by mere burial in this way, but the insects were too numerous for a thinly populated district to cope with, and they began to appear from all sides. As they got bigger and developed into the stage (bright yellow green) antecedent to fledging, vast armies marched directly upon the well wooded station of Kohat. They invaded every quarter of it. They crossed the roads resolutely, swam the water-courses, climbed the walls, filled the compounds, and scaled the trees, palings, walls of houses, and telegraph poles There was no nook or corner that was not alive with these hoppers, and wherever vegetation was thick it was seething with them. In a very few days the trees began to thin, and in ten days there were no leaves left anywhere. The station had all the appearance of winter. The gardens were stripped clean, rose bushes, vines, flowers, and every kind of plant being devoured wholesale. Trees with soft bark, and supple bushes, were so damaged that their stems and boughs were skinned. The only tree which the hoppers disliked for food was the "Bakain" or Persian lilac, and these trees have alone remained green, and for some reason the only flower they eschewed was the larkspur. Whether all the trees and bushes will recover or not is a matter of conjecture, but the Shisham and Mulberry trees and others are beginning again to shoot. I saw several Farash (Tamarisk) trees with their trunks red and raw from base to top where they had been stripped of bark. By the way the hoppers swarmed up and remained packed on the telegraph poles; they appeared to attempt to eat even their dry wood. The station exhaled the most offensive odours, for dead or alive the masses of insects stunk. Many of them entered the houses and ate holes in curtains and hangings. It was impossible to keep the rooms free of them. By congregating in one place in this way they they laid themselves

open to immense destruction. As much as 600 maunds of them were collected and buried in one day, and every day the destruction amounted to hundreds of maunds, nearly all the undetained citizens laboured, for one rupee was given for each maund weighed. The troops also, and the boys of the large High School, were engaged in destroying them. Their collection was very simple, as they could be shaken off the trees by thousands into sheets held below. Four men could collect a maund in very little time. There were three weighing stations established, and the District Funds were freely drawn upon. Some 40 paid labourers were entertained for special destruction in difficult places, but the paid labourer, unless watched the whole day long, contents himself with simply driving the insects about instead of killing them with his flail. On the energy of Mr. Casson, the Assistant Commissioner, seconded by Tahsildar Abdul Quyum, the success of the operations depended. Both these officers worked with a will. Mr. Casson spent several days in trying to save the municipal garden by himself setting an example in manual labour. Owing to his energy and the tahsildars' the destruction was very wholesale. After ten days the majority of the hoppers moulted their skins, and after waiting to get strength of wing, by degrees the whole of them left the station, where in any case there was no food left for them.

" As to the time locusts lay their eggs there is great room for conjecture. At the present moment (or at any rate to within the last few days) in the western portion of the district the *Acridium peregrinum* was obtainable in every phase of development from the eggs to the fully-fledged insect. The process of egg-hatching has therefore continued from the beginning of April to the beginning of June in a tract of country where the difference of elevation only causes a slight change of climate. It may be that the presence of hills accounts for this discrepancy, eggs in hills either taking longer to hatch or being laid later. A Financial Commissioner's circular of 1884 says that July is the ovipositing month of the Punjab locust, but I don't think this can be the case. It is more likely, as Dr. Cotes states, that August, September, and October are the months for the second layings. I do not think the recently fledged insects now flying about will lay for some time. It should be curious to see when the next swarms of larvæ will appear in this district (for the ones now appearing must be late ones of the April or spring brood). If the larvæ appear again during this autumn, it will be clear that there are without doubt two laying seasons in this quarter.

" The enemies of locusts were birds, beetles, and dogs, and the locusts also preyed upon one another. Birds did them very little damage, only attacking them occasionally. Pariah dogs devoured hoppers with relish. A black beetle, probably of the kind Mr. Merk sent a specimen of to Calcutta, attacked them with avidity. These beetles seem to be bred out of the fæces of the cattle, from which nest they appear in great numbers after the dropping is a day or two old. The large numbers of transport animals which have recently passed through the district to the Miranzai Expedition have caused the origin of large quantities of these beetles, and they were the locusts' most determined foe. When the hopper has just moulted his skin he is for some hours a most helpless creature, and in this state is often made a prey of by active hoppers still unfledged. Being no entomologist, I offer the remarks about the specimens I send with diffidence, but any contribution of information is of value in connection with an insect of which the best informed know very little."

Locusts in Northern Africa.

In the spring and early summer of 1891 the whole of Northern Africa was invaded by locusts of the species *Acridum peregrinum* Oliv. This locust (unlike the insect which proved injurious in Algeria in the years 1887-89) is the

one which has been destructive during the past few years in India, so the history of the invasion and the measures taken to combat it in Africa are of particular interest. Besides being destructive in India, *Acridium peregrinum* has been very prevalent, during the past few years, in Baluchistan, Persia, and along the Red Sea coasts, and the invasion of North Africa shows that the unusual multiplication of the species has not been confined to those of its breeding grounds which lie in South-Eastern Asia.

Acridium peregrinum has long been known to breed in the Sahara desert, and every few years it invades the cultivated land to the north. Algeria in particular is so subject to invasion from this species that a regular system of combating it has had to be inaugurated by the French Government. In the present year Tunis and Egypt seem to have been the chief sufferers. Algeria and Morocco, however, have also been invaded, while Tripoli has escaped.

Some excellent reports have been most courteously furnished, through the Government of India, by the British Consuls in Tunis, Algeria, Tripoli, and Egypt. In the cases of Tunis, and Algeria, the insect is specifically identified in the reports as belonging to the species *Acridium peregrinum* : in the case of Egypt it is referred to as *Acridium migratorium*, but as the specimens that have been picked up and sent to the Indian Museum by passing ships in the Red Sea, have invariably belonged to the species *Acridium peregrinum*, which has also been received from Persia and Baluchistan, it will probably be found that the locust which has invaded Egypt is the one so universally prevalent both to the east and also to the west of that country.

The history of the invasion of Northern Africa in 1891 has been very similar to that of previous invasions of the same region by this locust. The chief flights arrived in the spring from the direction of the Sahara desert, and laid eggs which hatched in the early summer. The young locusts, which emerged from these eggs, acquired wings by the middle of the summer, and by the latter part of the summer seem to have nearly completely disappeared. A good deal of damage was done to the crops in Egypt, Tunis, and Algeria, and most energetic measures seem to have been organized by the respective Governments for combating the pest, the result being on all hands admitted to have been very successful. The methods adopted seem to have been very similar to those used in India. They consisted chiefly in destroying the young locusts by driving them into pits or lines of fire, in frightening the winged flights off the crops, and in collecting the eggs. Of these measures the destruction of the young wingless locusts appears to have been the most generally successful. In Tunis a new agent that seems to have been very useful, both in destroying the young locusts and also in lessening the terrible smell which arises from their dead bodies was

creosote oil. This substance, which is known as "Huile lourde," is described as a product obtained by distilling coal tar: 20,000 kilos. of it were obtained from Oran, where the invention originated, for employment in places where fuel was scarce, but the destructive effects of the liquid, combined with its antiseptic properties, caused it to be universally preferred in Tunis to the former system of burning or crushing the locusts. The liquid costs from 11 to 13 francs per 100 kilos. It is mixed with one-and-a-half times its bulk of water, and is used both for sprinkling over small clusters of locusts in the morning and evening when they are banded together, and also for pouring over the masses of locusts that are collected in traps.

The chief reports that have been furnished on the subject of locusts in Northern Africa are as follows:—

(i) A report by Mr. Drummond Hay, on the methods adopted in Tunis for destroying locusts, originally published in the Miscellaneous Series, 1891, of Her Majesty's Foreign Office in London. This report has been reprinted in Volume II, No. 5 of these *Notes.*

(ii) A report on the incursion of locusts in Egypt in 1891, by Mr. Williamson Wallace of the Tewfikieh College of Agriculture at Ghizeh. In Egypt the flights appeared in the middle of April 1891 along the western border of Egypt, extending from Minieh in the south to the Mediterranean on the north. They appeared to come from the west, that is, from the direction of the Sahara desert, which has long been known as the home of *Acridium peregrinum.* They coupled as soon as they arrived, and a few days afterwards they began laying their eggs in the ground. The eggs hatched three weeks after they were laid, and by the middle of May the ground was covered with young wingless locusts. These young locusts became full grown and acquired wings in the latter part of June.

The following extract, taken from Mr. Williamson Wallace's report, shows the measures that were taken in Egypt to cope with the pest: —

"When the locusts appeared in Egypt no very decided effort was made to destroy them. Occupied at this period in reproducing their species, the locusts had done comparatively little damage to the crops. When, however, it was realized that they had actually bred in the country, and that Egypt was face to face with what might soon develope into a national calamity, a most energetic effort was made to get rid of the plague. Orders were issued from the Ministry of the interior to the Moodeers, pointing out the gravity of the situation and instructing them to use every means in their power for the destruction of the locusts. All available Inspectors were despatched to the provinces to assist the Moodeers, while officials were drawn from other departments and charged with this special work. By this time, namely, the 15th of May, the locust had spread to every province of Lower Egypt, except Dakahlieh, Menoufieh, and Gharbieh being the most affected. It was found that the eggs had been principally deposited on the sand islands along the course of the western branch of the Nile, and in the cotton fields. In the fields occupied by the winter crops, principally wheat,

barley, beans, and clover, scarcely any eggs were to be found; the ground at the time being too hard and dry to be pierced by the ovipositors of the locusts. This restriction of the infected area was of the greatest possible advantage. The cotton fields were comparatively empty; the young cotton plants gave little cover to the locusts, and caused little or no obstruction to the operations. Besides this, the proprietor of a cotton field at once reported the presence of locusts, since immediate action could alone save his crop.

"The most simple methods of destruction were found to be the most effectual, such as making long dry trenches 30 to 40 centimetres deep and 25 to 30 wide near to the young broods. Into these trenches the locusts were driven by bands of men and children, often numbering several hundreds, each armed with a palm branch. The men whose duty it was to dig the trenches then lined themselves along the further side of the trench, upon which the earth was thrown to prevent any locusts from escaping. When the locusts were driven into the ditch, the loose earth was at once pulled in by the band of people who had driven them, and trampled down firmly, so that none escaped. These methods proved very successful for the first three weeks. while the locusts were comparatively small, and before they had power to jump out of the ditches. At this stage, therefore, the ditch system became less useful, the locusts being now too wary to be driven easily into the trenches; and the consequent necessitated deepening of the trenches materially increased the cost of operations. It was found that when locusts were disturbed on open ground, such as a cotton field, they would go easily into any cover that was within reach, and remain there. Advantage was taken of this, and whatever available dry material there was in the neighbourhood was taken and spread in patches of several metres in diameter, or in long wide strips. The locusts were then driven into this ambush and surrounded by the people, who simultaneously fired the patch all round, resulting in the complete destruction of the locusts. The dry stalks of maize were plentiful in the country, and made excellent fuel for this purpose. These were the two effectual means by which the locusts were destroyed in Egypt within the space of six weeks. Few of the young ones ever got their permanent wings, and these few were speedily picked up by birds, the common crow positively feasting on them.

"Other means were tried, such as flooding the fields where eggs had been found, but this only retarded the hatching for a few days and destroyed the crops. The locust has considerable swimming powers, and will cross a wide canal if pushed to it. The fellah was very disposed to beat the locusts with his palm branch, instead of driving them forward to the ditch, which often resulted in the greater part of the swarm turning and escaping behind the line of beaters. The screen and trap system of Cyprus was tried with considerable care on the Tewfikien canal, the traps in this trial being lined with bricks. I rode over the ground a week later and found few locusts in those pits, many of which were empty; while quantities of locusts had been destroyed by the methods I have described. Short screens erected immediately in front of locusts are of no practical use, as the locusts are difficult to drive on to them, and the erecting of the screens has a tendency to frighten the locusts and to cause them to change their line of march. This system is only useful where locusts are known to exist on waste lands, and several miles of screens are erected along the edge of the cultivated lands, and thus arrest the natural march of the locusts. If they are to be attacked while they are yet small, and on their own breeding ground, as they must be, in Egypt, this system is too cumbrous for practical working purposes; and the money that would provide the screens is better spent in paying the people for destroying the locusts, and with methods involving no initial outlay whatever.

"Another trap and screen system, invented by Mr. Van Lennup, was tried on the

Nubarieh canal. Thin iron sheets took the place of canvas, and if it were not for the greater initial cost and heavier weight, this system is much superior to the Cyprus plan.

"Locusts may also be gathered by the hand for two hours in the early morning and for an hour after sunset. This semi-dormant condition might in future be taken greater advantage of, by gathering many of them before they deposit their eggs. Government did offer two piastres per oke for locusts, but the people did not seem to realise that they would be paid until most of the eggs were deposited. Two piastres an oke is a sufficient price to pay; and in future it would be well for the Moodeers to order out the people at once, whether they wish to come or not, and pay them for the quantity of locusts gathered at the end of the day. A few days delay may be fatal to the success of this method. The collecting of eggs was a failure. Two piastres per oke was likewise offered for eggs, but the impossibility of gathering them was soon apparent; the eggs were imbedded in the ground, and the digging of them up had the effect only of distributing them with the soil, which, moreover, in nowise affected their fertility. Only the eggs that were exposed on the surface of the soil were destroyed by the sun scorching them up. I experimented with locusts' eggs as to the depth at which the young locust could come up through the soil if the eggs were buried without the exit hole naturally left by the female locust. I found that at a depth of ten centimetres, all found their way to the surface; at twelve centimetres, about half came up; at fifteen centimetres, none of them came through.

"If the land was unoccupied, as it generally was not, ploughing would have the effect of destroying some of the eggs, either by burying or by exposing them on the surface. No satisfactory means was found of destroying the eggs.

"Small passing flights of locusts are frequently heard of in some parts of Egypt, but give no great cause for alarm; they have lately been reported at Suakim and at Wady Halfa.

"Forty years ago the locusts stayed and bred in the country in great numbers, and were exterminated by the people in much the same manner as this year. In the present year, practically no damage was done to the crops. Where the leaves were eaten off the young cotton plants, they sprouted again almost immediately, and became bigger trees than they would have been, but bearing a smaller amount of cotton."

(iii) The Consular report for the year 1890, on the agriculture of Algeria, by Consul General Playfair, published as No. 854 of Her Majesty's Foreign Office in London; also a letter, dated 30th October 1891, by Mr. Playfair, forwarded through the Government of India; and an account which appeared in the *Daily Telegraph*.

In the middle of December 1890 flights of *Acridium peregrinum* from the south-west were noticed in several cases in the extreme south of Algeria. On 19th March 1891 again Mr. Playfair wrote—"The crickets are appearing in various parts of the colony, but especially in the department of Oran, and the Prefects are busy organising means of defence. The Governor-General has made an urgent appeal for a supplementary credit of 500,000 francs for each department. The administration seems to be doing all that is humanly possible, but so widespread is the evil that it is doubtful whether they will be able to cope with it." On 30th October 1891, however, Mr. Playfair wrote that the result of the campaign waged against the locusts had been so sucessful that but little injury had been done to the crops.

According to an account of the locusts' invasion in Algeria, published in the *Daily Telegraph* in the early part of June 1891, reports of damage by locusts were coming in daily from all parts of Algeria, and large flights were observed in the Mediterranean. The mayors of the communes in Algeria were offering rewards at the rate of one franc for each 50 lbs. of locusts destroyed. Ploughing had been resorted to for the destruction of the eggs, but vast numbers of wingless larvæ had nevertheless emerged, and were doing great damage to the crops. The Cyprus screen system was being very largely used for the destruction of these larvæ, and smoky fires were found to be the best means of preventing the winged flights from alighting on the crops.

(iv) A letter, dated 3rd November 1891, from the Consul General in Tripoli, forwarded through the Government of India, noticing that although Tunis, Algiers, and Morocco had suffered from locusts, Tripoli had escaped.

(v) A notice which appeared in the *Board of Trade Journal*, London, June 1891, p. 684, on the subject of locusts in Morocco. According to this notice, locusts were first reported in Morocco in the southern province of Soos in the end of October 1890. Thence they spread over the country, and in the spring began egg laying, causing great anxiety for the spring crops. Damage also was done to green crops, and olive and almond trees were in many places stripped of their bark. No general measures were taken to deal with the locusts, though vast numbers were collected and sold for food both to Jews and Mohammedans. The locusts were brought in from the country on camels in the form of "heaving sackfuls," of ruddy brown or greenish-yellow insects (the first colour in the autumn, the latter in the spring). They were said to be first boiled in salt and water, and then fried or parched. The same *modus operandi* was said to have been in vogue, according to old writers, early in the last century, and when properly preserved the "Jeraad" appear to have been looked upon as a convenient form of food for travellers to take with them on the road.

Locusts in Persia.

The following report by Mr. W. Townley, on locusts in Persia, has been furnished through the Government of India by Her Majesty's Legation in Teheran. It will be interesting to ascertain the identity of the three species of locusts that are referred to in the report under the names of *Mesri*, *Daryaie*, and *Tauko*. For this purpose it would be desirable to obtain representatives of each of the species for examination by some trained entomologist. Up to the present little has been ascertained upon this

subject beyond the fact that the destructive migratory species *Acridium peregrinum* is often prevalent along the southern coasts of Persia :—

"There are no records of any flights of locusts having come as far north as the Teheran district, but it is reported from Kermanshah that locusts visit that district every five or ten years, and that visitations occasionally have taken place in two consecutive years. These locust visitations come from the Traki Arab, that is to say, from such districts as Karkoot, Suleimanieh, and Mosul. There are three distinct classes of locusts which visit the Shiraz district, and which are classified as the *Mesri*, *Daryaie*, and *Tanko*. The former always arrive from the direction of Lar and Sabeh, near the latter of which places there is a shrine called Alam Shah, where these locusts are said to come into existence, and from whence, after a few years, when their numbers have increased, they advance upon Lar Darab and Fasa. These locusts always travel from south to north, and when they have once left a place never return to it. The Daryaie locusts always appear from the direction of Bandar Abbas and Bushire, hence their name of sea-locusts. They eat nothing but the leaves of trees. The *Tanko* locusts have no wings. They live longer than the *Mesri* locusts, and their existence only terminates with the commencement of winter.

"In the hotter parts of the Kermanshah district locusts arrive about the end of March, when the fields are green, and at once set to work to devour the young vegetation. Near Kermanshah itself the locusts come out from under the ground about the middle of May. In the Shiraz district the date of the arrival of the locusts is fixed as being early in March. In the Kermanshah district oviposition takes place in the hotter regions about the end of May, and in the colder places about a month later. The eggs are hatched in the Shiraz district early in March.

"No remedial measures have been adopted in Persia, either by the Government or the people, for the extermination of locusts, though in Turkey the soldiers are sometimes ordered to assist to sweep up the locusts in the early morning when they are benumbed with cold, and to throw them into holes dug in the ground which are subsequently filled in with earth ; and also in that country locusts' eggs are purchased from the peasants, and the progress of the ravages of the pest is thus largely arrested.

"Locusts and their eggs are, however, largely destroyed by the following four natural causes: (1) rain during the hot seasons; (2) want of rain in winter; (3) the fact that after a few years they cannot lay eggs, and the generation of the species thus comes to an end; and (4) excessive cold; snow or hail kill the insects themselves if they are not grown up sufficiently to stand climatic changes. The following popular legend may also point to the starling as being a natural destroyer of the locusts. It is said that there is a spring at Kasvin, called Cheshmeh-i-Sar or the Starling's spring, and that if water is brought from this spring and sprinkled with certain ceremonies on the ground which is infested with this pest, large numbers of starlings appear and devour the locusts, thus preventing further devastation of the crops.

"The eggs of locusts are deposited at the foot of mountains or in hard places, and for 40 days after hatchings they are not provided with wings, and consequently cannot move about easily from place to place, but at the end of that period their wings grow and they set off on their flight, laying waste the fields which they pass on their way. Locusts live for 120 days, and during this short period of existence they lay eggs three times. Oviposition commences when they are 90 days old, and is repeated twice more, with an interval of 10 days each time, at the end of which three ovipositions they have reached an age of 110 days, and then after a further interval of 10 days they die. Each locust lays 90 eggs the first time, 70 the second, and 50 the third. The

locusts which are the results of the first oviposition are larger than those of the second, and those of the second oviposition are larger than those of the third. The above details as to the period of the existence and oviposition of locusts refer to those which are classified in Southern Persia under the name *Mesri* (Egyptian).

TEHERAN; *The 19th December 1881.* } (Sd.) WALTER TOWNLEY."

Locusts in Turkish Arabia.

The following notes on the locusts which have proved destructive in Turkish Arabia are of interest, as *Acridium peregrinum* (the migratory locust of North-Western India) seems to be the insect which is chiefly complained of.

According to a report by C. C. Metaxas, published in the *Revue des Sciences Naturells Apliquées*, 37, No. 12, June 1890, pages 584 to 590, reviewed in *Insect Life*, Volume III, page 172. *Acridium peregrinum* did much damage in the province of Mesopotamia in Turkish Arabia between the years 1884 and 1889, fresh swarms constantly invading the province in April from the south-east (*i.e.*, Southern Persia or Baluchistan). The early part of the winter of 1888-89 was an unusually mild one. The eggs hatched in January and the young locusts were killed by frosts in February, and it is supposed that the same conditions prevailed further eastwards, as there were no fresh invading swarms in the spring of 1889. A tax of 25 kilograms egg of capsules, to be delivered each winter, was imposed by the Turkish Government on each person in the cities, and for every plow in the country there was a similar tax of 50 kilograms. The result of these measures was that a large number of eggs were collected, and this, in conjunction with the frost in February, the failure of the spring rains which are considered essential to the hatching of the eggs, and the absence of fresh invading swarms from the south-east, resulted for the time in the cessation of the locust plague.

According to a report furnished through the Government of India from the British Residency in Baghdad, this locality is subject to invasion from two distinct species of locusts, the one coming from the district of Kerkook on the north, and the other from the direction of the Arabian deserts to the south. The following extracts from the Residency diaries are valuable as showing the nature and extent of the invasions :—

"*19th March 1886.*—The Local Government is making strenuous exertions against the locusts whose eggs the surrounding country is supposed to be full of. Yesterday both His Excellency the Wali and His Excellency the Commander-in-Chief, encamped outside the town to superintend the work of searching for eggs by detachments of soldiers. The young locusts are taken out of the ground in numbers: and in their present stage are small black wriggling creatures, something like spiders.

"*20th May 1886.*—For some time past the locusts have (while not diminishing in numbers outside) been invading the town, spoiling gardens, and entering the houses, where they have proved equally annoying to the inmates and destructive to household fittings.

"*17th June 1886.*—The locusts have now quite disappeared. The general belief is that, having laid their eggs, they have died, but it is noteworthy that no dead locusts are ever seen on the ground. This suggests the possibility of their having set off to new pastures, though it would be difficult for them to do so and escape observation.

"*11th April 1891.*—Locusts have now appeared—not from the skies, which is hardly ever the way of it in Irak, but from the ground, where their spawn has been buried, and myriads of them are now preying on the half-grown wheat and barley.

"*29th April 1891.*—The notable feature of the week is the rise of 40 per cent. in the price of wheat, owing to the extensive losses inflicted by the locusts in all the country round Baghdad."

Sulphur *versus* red spider.

A very complete and interesting series of reports by Mr. G. F. Playfair, on the results of experiments conducted in Cachar upon the subject of the sulphur treatment for red spider, have been furnished by Messrs. Barry & Co. Five tons of refined flowers of sulphur were sent up to the garden for application as a remedy against red spider (*Tetranychus bioculatus* W.M.), which is one of the tea planters' most inveterate enemies. The sulphur was applied over an area of 138 acres, and the results appear to be so successful that the treatment seems likely to prove of the very greatest value.

The method adopted was to put the sulphur into bags made of loose woven cloth and sprinkle the tea bushes by simply shaking these bags over them. In some cases the bushes were first splashed with water, but in localities where water was not easily obtainable the sulphur was applied without any previous watering. The sulphur was found to adhere fairly well, even on dry bushes, in spite of the high wind which blew both at the time that the sulphuring was going on and afterwards. The average cost of the treatment has been estimated by Mr. Playfair at R8-4 per acre, including the price and freight of the sulphur and the cost of application. The sulphur was applied in the first instance at the rate of one hundredweight to the acre, but a large area was afterwards sulphured at the rate of two hundredweight to three acres, and an experiment was made over eleven acres of sprinkling a mixture of one part of sulphur with two parts of sifted lime. The last application does not appear to have been so successful as the undiluted sulphur. Besides destroying the red spider most effectively, Mr. Playfair is of opinion that the sulphur treatment is also useful against the mosquito blight (*Helopeltes theiovora* Moore), which is perhaps an even more destructive pest than red spider. Upon this point it will be useful to make further observations, as mites (such as red spider) are the only pest against which

sulphur seems to have hitherto been successfully used in other parts of the world.[1]

14th March 1892.—"I am taking advantage of the present hot weather to apply the sulphur as advised by Mr. Christison, who makes a point of putting it on during times of bright sunshine. I find the quantity used is exactly one cwt. to the acre, and cost of application R1-6. Up to date I have sulphured 60 acres, and will keep on as long as the sulphur lasts, or the drought continues. I have given up my original intention of applying half now, and the balance when red spider becomes active, as I find in places a good deal of blight is already visible, and I am hopeful that the sulphur will stamp it out before the insect has time to propagate. Some experiments with the mosquito itself tend to show that it dies if lightly dusted with the sulphur."

25th March 1892.—"Red spider began to show itself all over the early pruned sections, but I applied the sulphur as fast as I could, and whenever the application was made not a trace of spider remains. Altogether 138 acres have been sulphured with the 5 tons sent up. The sulphuring has been most carefully done, either a Babu or Mr. Burns being in constant attendance, and as far as can be judged at this early stage the experiment is likely to be a very remunerative one. Whether or not the spider will come back remains to be seen, but at the present moment I can guarantee there is not a single affected bush over the whole 138 acres."

13th April 1892.—"The drought still continues, only ·86 inches of rain having fallen in April, the total to date since the 1st January being 4·05 inches. Notwithstanding, Bundookmara is looking very well and would flush at once with rain. The great heat and dryness of the soil have brought on some red spider, but not much, as the early pruned sections were all sulphured, and the later pruned have not yet sufficient foliage to make red spider harmful. It is gratifying to observe that not a single plant over the sulphured area shows the slightest sign of red spider, and blight which had appeared with the first growth has also entirely disappeared. I believe that in dealing with the one disease, we have also dealt with the other, and that the early part of the season will be free from blight."

18th April 1892.—"There have been no charges in connection with the sulphur, it having been brought up to the garden by my own boats. From the invoice, and estimating for freight, I make out the five tons have cost approximately R900 and applied to the bushes about R8-4 per acre. A very small increase in yield will cover the expense, and I am hopeful, from the look of the sulphured sections, of proving to you that the money has been well spent. You must not expect to see any very startling increase in outturn in consequence of the sulphuring, as I have naturally treated those flats which are the poorest and most in want of encouragement, but if by doing away with spider and possibly blight, I can in time bring these flats from poor to good; the gain will be great indeed. At the present moment I believe that the application of sulphur will result in an increase of a maund of tea per acre; it certainly will be so if blight is mitigated as well.

"I have written out extracts from my diary giving you full particulars respecting

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[1] It may be noticed that washes made of soap and sulphur combined have been recommended both in the United States and in England for use against mites like the *red spider*. The wash is sprayed on to the plants by means of a force pump fitted with a nozzle to give a very finely divided spray. This method of applying the sulphur may possibly prove cheaper and more effectual than dusting it on to the leaves, though Mr. Playfair's experiments with sulphur in powder seem so successful as to leave little to be desired. Compounds of soft soap and sulphur can now be purchased in England ready made, so as only to require the addition of water. In her fifteenth annual report on Injurious Insects, Miss Ormerod mentions the Chiswick Soap Co., of Chiswick, England, as a firm from which the mixture can be procured.

the way the sulphur was applied, the state of the bushes before, and the immediate result after application. It will be interesting to compare this report with subsequent ones which I will send from time to time in the same form."

Abstract of Diary.—"The treatment was begun on 7th March 1892 and completed on 21st of the same month. Sixty acres were treated at the rate of one hundredweight to the acre, which gave a very sufficient sprinkling, sixty-seven acres at the rate of two hundredweight to three acres, while eleven acres were treated with a mixture of one part of sulphur to two parts of sifted lime. The tea that was treated was of the " China " variety. The bushes were rather below than above the medium size. They had not put out much growth owing to the drought. Red spider had appeared, and careful examination showed that it was present in many places. The application of the sulphur was made through *markin* cloth by simply shaking the bag over the bush. Where water was available the bushes were first splashed with water, but over a considerable area the application was made without previous watering. The sulphur adhered fairly well even on dry bushes, in spite of the high wind which blew both at the time that the treatment was going on and afterwards. The average cost of applying the sulphur was about R1-4-9 per acre, including the purchase both of the cloth and also of the *kulcies* for watering. As far as could be made out, *provided the sun was strong,* bushes powdered in the morning had all the red spider killed by evening. After sulphuring the bushes were examined daily, but the only bushes on which red spider could be found were one or two, which had been treated with the mixture of lime and sulphur; even here, however, very careful search was required to find live insects. On 16th April it was noted that red spider was to be seen in all parts of the garden except the sulphured area, while neighbouring gardens were very much affected by it. The sulphured area was the first pruned and, should, under ordinary circumstances, have been the most affected. With regard to the effect of the sulphur treatment on mosquito blight, some mosquito blight insects were caught and experimented with on 23rd March. When sulphur was powdered on to them it adhered to the hairy parts of the body and legs to a considerable extent, but the insects did not die at once, though putting them in this state under a glass in the sun was fatal to them. After applying the sulphur all signs of blight disappeared, careful search not revealing a single punctured shoot. It must be added that little blight could be found on other parts of the garden but the flats which had been treated with sulphur were always the ones to be first attacked."

6th May 1892.—" I have no objection whatever to Mr. Cotes making use of any information he may have derived from my writings, and will be glad to supply him with further notes from time to time. I strongly object however to trying Mr. Cotes' suggestion about sulphur soap instead of the pure sulphur (except as a supplementary experiment) for this reason.

" The action of sulphur against red spider is now proved beyond doubt, and requires no comment. It also seems to have killed off the blight insect; and if this is a fact it would be a vast pity to operate against the one disease without the other in future, for the sulphur soap wash however efficacious against spider could not be expected to do much harm to a winged insect like blight. Moreover, the wash requires special apparatus for application, and the purchase of such in sufficient quantity to go over hundreds of acres quickly would be prohibitive. That blight has actually been killed out over the sulphured area seems to me a certainty. On the 14th March I wrote to you saying that my original plan of distributing the sulphur had been changed owing to a considerable amount of blight being noticeable. This is proof that blight *was* there ; it is equally certain there is none *now*, and the accompanying extract from my Diary will prove that during the past ten years I have invariably reported blight not later than the week ending the 23rd April, and almost always in the same spot, which this year is free. I am not yet in a position to ask you for a further and larger supply of sulphur

for next year, but trust to be able to do so when I can lay the result of the pluckings of the sulphured and non-sulphured areas before you."

Tomato decoction for red spider.

An experiment in applying an insecticide, formed of a decoction of tomato leaves, for the destruction of *red spider* (*Tetranychus bioculatus* W. M.) on tea bushes, has recently been recorded in the publications of the Agri.-Horticultural Society of Calcutta. The experiment was made by Mr. W. Weston of the Senigell Tea Company in Assam, and the results, so far as the experiments went, seem to have been to some extent encouraging, though the labour required was very great, and the cost was much heavier than in the case of the sulphur treatment described in the preceding section.

The decoction was tried upon a small scale, and Mr. Weston found that it thoroughly extirpated the red spider, without injury to the tea bushes. The treatment had no effect upon the yield of the bushes, for it was found that, as long as a tea bush is suffering from red spider, it does not flush, and as soon as the pest is destroyed the treatment can be discontinued.

A number of applications were found necessary to destroy the blight, some of the bushes being sprayed, morning and evening, for from eighteen to twenty-seven days before blight was killed; eventually, however, the blight was effectually destroyed. The cost of the treatment was considerable, one hundred and thirty rupees being the estimated cost per annum of destroying the blight on one acre of infested tea; but as red spider is found to start on a few bushes, whence it spreads over a garden, Mr. Weston expects that by keeping a sharp look-out and using the decoction to destroy the blight on the bushes, where it first appears and before it has time to spread, there will be no need to spray any considerable area.

The directions for preparing and applying the wash are given as follows:—

"Take 80 lbs. of tomato leaves and stalks (bine), throw a portion into a cask, and pulp well with a long wooden mortar. Continue adding till the whole of the 80 lbs. is pulped; then add 40 quarts of water and mix well. The decoction is now ready for use. Old leaves and bine which are stringy are useless............The best and quickest method of applying the decoction is with syringes with rose heads. Syringe the bush thoroughly morning and evening."

The tomato plant grows with great freedom, so a supply of the materials for making the insecticide is said to be readily procurable.

There has long been a tradition that the tomato plant has certain insecticide properties, but the few records that have been published of attempts made in America to utilize tomato decoctions as insecticides

have been so unfavourable that it is not surprising the plant has attracted but little attention in this connection. It will be interesting therefore to ascertain whether subsequent experience confirms the favourable opinion formed of the decoction by Mr. Weston.

London purple insecticide in Madras.

A small quantity of some London purple, supplied to the Indian Museum for experiment by Messrs. Hemingway & Co., of London and New York, also a force pump similarly supplied for experiment by Messrs. Rumsey & Co., of New York, were forwarded to the Madras Museum in January 1889 for experiment upon the caterpillar *Achæa melicerte* Drury, which was reported as doing a considerable amount of damage to castor oil plants in the Madras Presidency. The insecticide seems to have reached Madras too late for use against this caterpillar, but a report has been furnished, through the Madras Board of Revenue, of some experiments made with it by the Government Botanist in July 1891. These experiments were made upon scale insects, red spider, and Aphidæ, for which London purple is not usually recommended, as they all feed by drawing up the juices of the plant through a narrow proboscis which is inserted into the tissues of the leaf or shoot. They are therefore little effected by a poison like London purple, which usually requires to be taken into the stomach, though cases have been found, as for instance, that of the leaf hopper which attacks mango blossom, where it is effective against haustellate insects. It is to be boped that in the further experiments which it has been proposed to make in the College of Agriculture, Madras, attention will be chiefly directed to mandibular insects, such as caterpillars and beetles, which eat the substance of the plants and are thus likely to take the London purple into their digestive organs.

The following is an extract from the report furnished by the Government Botanist, on experiments made with the force pump and London purple furnished to the Madras Museum :—

"The results have not been so satisfactory as I expected; a strong solution failed to kill scale; a weaker solution proved destructive to red spider and aphids, when the fluid was brought in contact with them; but the insects on the under surface of the leaves were often untouched by the spray and so escaped. The stronger solution killed the leaves of the plants to which it was applied. The solution itself is no doubt a useful insecticide, and it is the method of applying it only which is not quite satisfactory, as the pump is not suited for directing the spray to the under surface of the leaves."

Sugarcane borer.

An interesting report on the sugarcane borer (*Diatræa saccharalis* Fabr.), by Mr. L. O. Howard, appears in *Insect Life*, Vol. IV, page 95, Washington, 1891.

After a careful review of what has been ascertained about this destructive insect, Mr. Howard concludes that it attacks all four of the closely related species of plants *Sorghum vulgare*, *Saccharum officinarum*, *Tripsacum dactyloides*, and *Zea mays* in the United States. Mr. Howard adds—

"The brown spots on the midsummer individuals in corn [1] in South Carolina and Virginia affords no argument for the non-identity of the sugarcane and corn borers. Moreover, specimens from sugarcane from Florida collected in October of the present year show the brown spots and variation of the colour of head and prothoracic shield noticed in corn specimens, and are in fact indistinguishable from these. In addition to this, from my observations in Westmorland country Va., the past August, it seems probable that the loss of the spots is characteristic of the perfectly full-grown larva, as at this late date the few delayed individuals of the first brood are all white." In a foot-note Mr. Howard adds—" Professor Riley, who has examined the moths, both from corn and sugarcane, since the above was written, finds that they all belong to one species. Of over fifty specimens reared there is great variation both as to the distinctness of the transverse lines and of the terminal series of dots, and as to the general ground colour. It is also noticeable that the later-bred specimens from the south are, on the whole, darker. The males are generally much darker than the females. The material leaves no question that *obliteratellus* Zeller, and *crambidoides* Grote, are, as they have been made by Professor Fernald, merely synonyms."

The question of the specific identity of the borers which attack *sugarcane* (*Saccharum officinarum*), *cholum* (*Sorghum vulgare*), and *maize* (*Zea mays*) is an important one in India, where they do a great deal of damage to all three crops; and it is very desirable to settle definitely to what extent the refuse of sugarcane (for instance) is liable to breed moths that will lay their eggs in fields of cholum or maize that happen to be in the neighbourhood.

A number of moths have been reared in Calcutta from affected sugarcane that has been sent to the Indian Museum, and though they differ from each other a good deal both in size and coloration, they seem likely to prove to be merely varieties of one species. Moths also have been reared in the Indian Museum from caterpillars found in maize, and these also seem without doubt to be identical with the moths reared from sugarcane. In the case of cholum, a number of infested stalks were sent to the Museum, but the attempts that were made to rear the moth were not successful, owing to the fact that almost all the caterpillars were found to be suffering from the attack of a chalcid parasite [2] which proved fatal to all its victims. As far as could be made out the caterpillar was the same as the one found in sugarcane. It is interesting to notice, in this connection, that, owing to the fact that it is always

[1] Corn = *Zea mays*, Ed.

[2] Since described by Mr. Peter Cameron as *Colesia flavipes* n. sp., see Mem. Manchester Lit. and Philos. Soc., 1891.

much easier in Calcutta to procure sugarcane stalks than either sorghum or maize stalks, sugarcane was used for rearing the borers sent to the Museum as attacking both maize and sorghum. Borers taken out of maize shoots were reared in sugarcane from the time they were comparatively small caterpillars until they emerged as moths, and a sorghum borer (the only one of a set received from Poona that escaped the chalcid parasite) was reared in sugarcane from the time it was a half-grown caterpillar until it reached the chrysalis stage, when it was accidentally injured and thus prevented from emerging as a moth. The caterpillars taken both from maize and sorghum stalks seemed none the worse for being fed upon sugarcane, and this appears of itself to be a strong reason for supposing that the three insects are identical. It would settle the point however if it should prove that the American species which has now been shown to attack all three plants is also the one that occurs in India, and a moth therefore, reared from sugarcane in Calcutta, has been sent to Washington for comparison with the specimens that have been reared in the United States[1].

Grain storage to exclude weevil.

The following letters, furnished in response to inquiries made by the Director of Mines and Agriculture in New South Wales, on the subject of the methods adopted in Australia and the United States for protecting grain from weevil, are of interest in view of the great injury done by grain weevils in India.

In the October number of the *Agricultural Gazette* of New South Wales (Sydney, 1891), the Under-Secretary to the Queensland Department of Agriculture writes—

"The system of storing maize in tanks has been in vogue in this colony for some time past, but I am not aware, nor have I heard, that the tanks are made of steel. Tanks of various kinds and shapes have been used, from the square 400-gallon ship tanks to the round corrugated-iron tank of the cottage; then, again, tanks of galvanized iron have been specially constructed, having a capacity to suit the amount of grain to be stored. Several of our farmers have tanks of a capacity of 1,000 gallons in use, some even being larger, and fitted with traps at the bottom to facilitate discharge when bagging. Different methods of securing the keeping qualities of the

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[1] In reply Dr. Riley, the United States Entomologist, writes: "I must confess that I am rather disappointed in finding that your sugarcane borer is not the same as ours. It is a *Chilo* and not a *Diatraea*, and comes near *C. plejadellus* Zinck. which bores into rice in our Southern States, but it differs in the very clear cut terminal dark line between the black spots and fringe. The specimen is badly rubbed, and I cannot be certain of its exact specific position. It is possible that it may be identical with *Chilo infuscatellus* Snell., which infests sugarcane in Java.......I believe that you are perfectly right in assuming that the borers in sugarcane, sorghum, and maize are all the same, and it is interesting to know that at least one other crambid agrees with *D. saccharalis* in this particular."

grain are adopted: (1) thorough kiln drying is resorted to prior to putting the grain in the tanks; (2) bisulphide of carbon, the use of which does not injure the grain, being of a very volatile nature the fumes soon pass away; (3) the placing of a small piece of candle lighted on the top of the grain and then screwing the lid down very tight, the object being to secure an air-tight chamber. The two latter methods are most in vogue, and *are most successful in their results*, the grain keeping perfectly for a period. Although this system of storing grain is adopted in several districts in this colony by farmers, yet that part of the colony where it has been most largely resorted to is what is locally known as the Isis scrub, in the Bundaberg district."

In the December number of the same periodical, Mr. O. Clute, President of the Agricultural College of the State of Michigan, United States, America, writes—

"I have had no experience or observation as to storing grain in metal cylinders or tanks, hence can give you no information on this point. I do not think this method is much followed in the States. The attacks of the weevil and some other insects have been of serious character in some parts of America, resulting in great pecuniary loss. A method of destroying such pests, and of protecting mills, granaries, elevators, etc., against their ravages, was tried by the experiment station a few years since. It has now been used by large millers and dealers in grain with perfect success, and we recommend it with confidence. As it can be used in any ordinary building, at a comparatively light cost, it seems to me better than metal tanks or cylinders. Indeed the metal tanks can give no protection unless you are sure that the grain is free from eggs when it is put in, and then that the tanks are hermetically sealed, so as to prevent the insects from getting at the grain and laying eggs.

"We use bisulphide of carbon, which rapidly evaporates, and makes a dense vapour, which settles down through the grain and penetrates to every crack.

"The method of application adopted in America is to close up the room or store as nearly air-tight as possible immediately after having sprinked the bisulphide over the grain, at the rate of about 1½lb. to the ton, when, being heavierthan the air, its vapour sinks down through every interstice. This carbon bisulphide is not so injurious to human life as some other vapours, but it is very explosive when mixed with air, and therefore great care should be taken not to bring a light near when it is being applied. It evaporates so quickly that it can be thrown on any grain without injuring it in any way. After opening the can in which the bisulphide is received, no time should be lost in using, but the contents should be at once scattered in the bins, and the doors or covers closed as quickly as possible, and kept closed for 24 hours, to give time to the vapours to act and reach every corner."

In the January number of the same periodical (1892) the Editor writes—

"The following information and accompanying plan are results of further inquiries by the Department in connection with various methods for the safe storage of grain:—Steel tanks were recommended, and an application was therefore made to Messrs. Hudson Brothers (Limited) for designs, together with their quotations as to cost. It will be seen that the design supplied shows two sizes, with provision for fumigation. They would be built of steel plates, and the estimated prices are, for the smaller size, £99 15*s*. complete, free on rail at Granville; and for the larger, £465, in sections ready to put together, also free on rail at Granville. On receipt of these documents the Director wrote, pointing out that the prices quoted were beyond

the reach of farmers of ordinary means, but thanking them for the drawings, which would be reproduced in the Gazette, in order that agriculturists might become acquainted with the scheme, and that in course of time a demand might arise if the prices could be lowered. In reply to this letter Messrs. Hudson wrote, explaining that the prices could be but little, if at all, improved upon for receptacles of the capacity named; smaller tanks, if of any service, could be made at a reduced cost nearly in proportion to diminution of size. The quotations are for best material and workmanship, as the weight of grain would be considerable, but Messrs. Hudson expressed themselves as being willing to consider any suggestions for a cheaper form of tank.

" In reply to communications by the Department, two further letters have been received from America: one from the United States Department of Agriculture at Washington, and the other from the State Agricultural College of Texas, both intimating their inability to give any information regarding the use of steel tanks for grain storage."

Contagious disease germs *versus* insects.

The contagious diseases which attack insects have lately been attracting a good deal of attention, and some interesting papers have been published in the periodical *Insect Life* (United States Department of Agriculture, Washington, 1890-91) on the subject. It has long been known that silkworms, house flies, and clinch bugs are very subject to the attack of contagious diseases, and various other insects also are said to suffer to a considerable extent. The question therefore is an important one both on account of the possible utilization of these diseases in fighting insect pests, and also in connection with the obscure subject of the causes which produce the undue multiplication at one time and the undue suppression at another of common species. These being marked features of insect life in India as in other parts of the globe.

In Algeria MM. Künckel and Langlois have been experimenting with a cryptogamic disease (*Lachnidium acridiorum*) said to attack migratory locusts in Africa (vide *Insect Life*, Vol. IV, p. 151; and Bull. Soc. Ent. Fr., 24th June 1891). In France Messrs. Fribourg and Hesse of 26 Rue des Écoles, Paris, are advertising for sale spores of a vegetable parasite which they claim can be used for the destruction, by inoculation, of white grubs (Melolonthidae), *vide* Insect Life, Vol. IV, p. 152; while an interesting series of investigations have been carried on in the United States by Mr. F. H. Snow, who has been experimenting with the diseases to which the clinch bug (*Blissus leucopterus*) is subject.

In a paper read before the Committee on Entomology of the Association of American Agricultural Colleges and Experimental Stations held at Champaign Illinois on November 12th, 1890, and subsequently in a paper which appeared in Insect Life, Vol. VI, page 69, Mr. F. H. Snow describes his experiments in infecting healthy clinch bugs by scattering diseased individuals amongst them. Mr. Snow's experiments were conducted upon a considerable scale, and he regards the results upon the

whole as satisfactory. The method adopted was very simple. It consisted in shutting up healthy clinch bugs for a few hours in a jar containing diseased individuals. The insects thus infected were scattered broadcast over fields infested with the pest, with the apparent result of a great spreading of the disease and a consequent diminution in the numbers of the clinch bugs. The diseases which were disseminated were of several kinds. They included a bacterial disease due to an organism identified as *Micrococcus insectorum* Burril, and at least two distinct fungoid diseases. Of these diseases the *Micrococcus* has long been known to attack the clinch bug (*vide* Cruickshank's Introduction to Practical Bacteriology, London, 1886), and it is probably one of the most important. It is described in a paper by Professor A. S. Forbes, quoted in Insect Life, Vol. IV, p. 88. Professor Forbes found that it attacks a portion of the digestive tract of the insect, and that, at one time, it was so universally present that he was unable to find any unaffected clinch bugs for experiment in connection with the fresh inoculation of the disease. This feature, in connection with the necessary liability to error in evidence upon so technical a subject collected from farmers in the field, would seem to indicate that the subject will require a good deal more investigation before any very certain conclusions will be justifiable as to the practical results to be expected from the methods adopted by Mr. Snow. In this connection Professor Forbes writes (*North American Practitioner*, September 1891, quoted in Insect Life, Vol. IV, p. 88)—

"Concerning the utilization of artificial cultures of Micrococcus for a propagation of this disease among insects not affected, I am at present able to say but little, as I have not yet succeeded, in either season when it was common, in finding lots of clinch bugs sufficiently free from it to make them suitable subjects for experimental attempts at its transfer. It will be readily understood by any one that it is useless to test the utility of artificial cultures of the disease germs by applying them to insects which are already affected by the disease in question. The first step of any really scientific investigation of the economics of this matter is to determine positively the absence of the disease in the lots of insects to be used in the experiments. Every lot of clinch bugs thus far obtained by me from Central, South Central, and Northern Illinois during the months of July and August of this year, gave evidence, under critical study, of the presence of this microbe in the cœca of a larger or smaller percentage of pupæ and imagos. My previous observations—less carefully made, however, than my recent ones—have been to the general effect that hibernating clinch bugs and young preceding the so-called pupa state are little liable to the spontaneous occurrence of the intestinal trouble, and I consequently do not despair of finding, before the present season is over, opportunity for experiments which will determine beyond question the economic value of this clinch bug cholera."

The following extracts are taken from the reports of Mr. Snow's papers upon the subject as published in *Insect Life*, Volumes III and IV:—

"As Entomologist to the Kansas State Board of Agriculture I had prepared an article for the annual meeting of that Board in January 1889, stating what was

known at that time upon the subject, and calling attention to the investigations of Professors Forbes, Burrill, and Lugger. In June 1889 a letter was received from Dr. J. T. Curtiss, of Dwight, Morris county, Kansas, announcing that one of the diseases mentioned in the article (Entomophtora) was raging in various fields in that region, and stating that in many places in fields of oats and wheat the ground was fairly white with the dead bugs. Some of these dead bugs were at once obtained, and experiments were begun in the entomological laboratory of the university. It was found that living, healthy bugs, when placed in the same jar with the dead bugs from Morris county, were sickened and killed within ten days. A Lawrence newspaper reporter, learning of this fact, published the statement that any farmers who were troubled by clinch bugs might easily destroy them from their entire farms by sending to me for some diseased bugs. This announcement was published all over the country, and in a few days I received applications from agricultural experiment stations and farmers in nine different States, praying for a few 'diseased and deceased' bugs with which to inoculate the destroying pests with a fatal disease. Some fifty packages were sent out during the season of 1889, and the results were in the main highly favourable.

"It was my belief that sick bugs would prove more serviceable in the dissemination of disease than dead bugs. I accordingly sent out a circular letter with each package, instructing the receiver to place the dead bugs in a jar for forty-eight hours, with from ten to twenty times as many live bugs from the field. In this way the disease would be communicated to the live bugs in the jar. These sick bugs being deposited in different portions of the field of experiment, would communicate the disease more thoroughly while moving about among the healthy bugs by which they would be surrounded. This belief was corroborated by the results. The disease was successfully introduced from my laboratory into the States of Missouri, Nebraska, Indiana, Ohio, and Minnesota, and into various counties in the State of Kansas. A report of my observations and experiments in 1889 has been published in the Transactions of the Kansas Academy of Science, Vol. XII, pp. 34-37, also in the Report of the Proceedings of the Annual Meeting of the Kansas State Board of Agriculture in January 1890.

"The next point to be attained was the preservation of the disease through the winter, in order that it might be under my control and be available for use in the season of 1890. To accomplish this result I placed fresh, healthy bugs in the infection jar late in November 1889, and was pleased to note that they contracted the disease and died in the same way as in the earlier part of the season. I was not able to obtain fresh material for the purpose of testing the vitality of the disease germs in the spring of 1890 until the month of April, and then only a limited supply of live bugs could be secured. I quote the following from my laboratory notes:—

"April 10th, twenty-five clinch bugs that had hibernated in the field were put in the infection jars. They were supplied with young wheat plants. The bugs appeared lively and healthy.

"April 16th, some of the bugs were dead, and all appeared stupid.

"April 20th, all of the bugs were dead.

"One week later a new supply of fourteen bugs was put into the jar; they were supplied with growing wheat. They ran substantially the same course as the first twenty-five. Some had died at the end of the first week, and all were dead by the end of the thirteenth day.

"The clinch bug seemed to have been very generally exterminated in Kansas in 1889, and only three applications for diseased bugs were received in 1890 up to the

middle of July. On account of the limited amount of infection material on hand, I required each applicant to send me a box of live bugs, which I placed in the infection jars, returning in a few days a portion of the sick bugs to the sender. The three applicants above noted reported the complete success of the experiments.......

"Before the close of the season of 1890 it became evident that there were at least three diseases at work in our infection jars, the white fungus (*Entomophthora* or *Empusa*), a bacterial disease (*Micrococcus*), and a fungus considered by Dr. Roland Thaxter to be *Isaria*, or perhaps more properly *Trichoderma*......

"The following is a summary of the results of the field experiments in the season of 1890 :—

"Number of boxes of diseased bugs sent out, thirty-eight. Seven of these lots were either not received or received and not used. Reports were received from twenty-six of the thirty-one remaining cases. Of these twenty-six reports three were unfavourable, nineteen favourable, and four doubtful concerning the success of the experiment. These doubtful cases are not to be looked upon as unfavourable, but more evidence is needed to transfer them to the list of favourable reports. Thus nineteen out of twenty-six reports, or 73 per cent., were decidedly favourable. The experiments will be continued during the season of 1891. In presenting this paper I wish to acknowledge the invaluable aid continually received during the progress of the work from my assistants, Messrs. W. C. Stevens and V. L. Kellogg.

"The laboratory experiments have been continued through the season. Of the three diseases identified, that produced by the Trichoderma appears to be less fatal than the other two.........

"To Mr. Riley's question as to which of the three diseases mentioned was most common in destroying the bugs in the field experiments, Mr. Snow said during the dry summer of the present year he thought the bacterial disease did most of the work, but in 1889 he thought the fungous disease were most destructive.

"Mr. Riley said that the fact that Mr. Snow had been able to carry healthy bugs through the season without infection in the same room with diseased bugs was a rather discouraging one, as it would indicate either that the germs were easily kept from reaching the bugs or that they were not carried long distances. Close proximity to, or actual contact with, diseased individuals, if necessary, would materially lessen the value of their use in the field, while the evidence of farmer's experience in the field needed very careful weighing, because of the possibilities of error. Mr. Snow said that it had been found by his experiments that the diseases would spread over large fields and destroy nearly all the bugs within ten or twelve days after the diseased bugs had been introduced, and that the expense was very light." (Insect Life, Vol. III, pp. 279-285.)

"In response to your circular letter asking for notes of work done in economic entomology during the past year (1891), I beg to submit the following brief and incomplete account of the work done in Kansas this year under my direction in the matter of the artificial dissemination of a contagious disease or diseases among clinch bugs :

"The legislature of the State of Kansas at its last session in the winter of 1890-91 made an appropriation of 3,500 dollars, available during the year 1891-92, for the purpose of carrying on these experiments. With this money I have been enabled to largely increase the facilities of my laboratory, and to conduct on a rather extended scale practical experiments in the field. According to a provision in the act of appropriation, I am required to make a monthly report to be printed in the official

State paper of Kansas, the *Topeka Daily Capital.* From my last report, made on July 15, I quote as follows:—

"Since making the last report, June 15, the wheat has ripened and mostly been harvested. The clinch bugs at harvest time left the wheat fields and invaded the fields of young corn. The experiments of 1889 and 1890 were carried on among bugs in the corn-fields, and the experiments of this year in wheat fields are thus new features in the work. The results have been gratifying, but the reports from this year's corn fields and the investigations of my field assistant, Mr. Hickey, show that the massing of the bugs in the hills of corn offers more favourable conditions for the successful workings of the disease than the usual conditions incident to the presence of bugs in wheat.

"The hatching and appearance of the young bugs is a feature in the work added since the last report. It is with satisfaction that I note the communicability of the disease from old to young bugs by contact. The young bugs are as susceptible to the infection as the old ones.

"The part of the State reporting bugs in the corn-fields lies between 96° 30′ and 98° 01′ west longitude; or between a line drawn through Marshall, Pottawatomie, along the eastern boundary of Geary, Morris, Chase, and along the eastern boundary of Greenwood, Elk, and Chautauqua Counties, and a line drawn along the eastern boundary of Jewell, Mitchell, Lincoln, Ellsworth, Rice, Reno, Kingman, and Harper Counties. This bug-infested belt extends clear across the State from north to south. Scattering reports of the presence of the bugs are in from various eastern counties, and from a few west of the 98° 30′ line.

"Up to date (11 A.M., July 15) infected bugs have been sent out from my laboratory to 1,700 applicants. To several of these applicants second lots of infected bugs have been sent, owing to failure to use the first lot for various reasons, and occasionally because of failure to get good results from the first experiment. But as many, if not more, persons have got dead bugs from fields wherein the bugs are dying because of infection sent out from my laboratory as have received bugs directly from me. Each successful field experiment has been the means of establishing a secondary distributing centre. It is evident that the experiment of killing clinch bugs by infection with fungoid and bacterial disease is being given a trial on a large scale. The reports for the past month (June 15 to July 15) have been gratifying, in that they show a good percentage of success. However, reports are not made out as carefully as they should be, and worse, many experimenters make no reports. I desire to have a report on every lot of infected bugs sent out.

"Because of the difficulty of getting careful reports from the field, I sent out Mr. E. C. Hickey, an intelligent University student doing special work in natural history, as a field agent. Mr. Hickey's last trip was through Chautauqua, Harvey, Sumner, Cowley, Butler, Greenwood, and Elk Counties, lasting from June 12 to July 6. He visited seventy-two persons who had experimented with infected bugs, and found over 80 per cent. of the seventy-two experiments successful. Mr. Hickey personally visited the corn-fields, and verified by careful observations the statements of the farmers.

"The laboratory facilities for sending out infected bugs have been largely increased, and all demands can be promptly met. Application for infected bugs received in the morning's mail are answered with bugs and directions on the noon outgoing trains. The work of scientific investigation in the laboratory is going on steadily and carefully. Inoculation experiments from pure cultures of *Sporotrichum* will be reported on next month. A feature of the work unnoticed previously in this report is the prevalence of *Empusa*, the fungus with which the first successful

experiments were conducted. *Empusa* and *Sporotrichum* develop side by side in the infecting cages, and dead bugs sent in from fields where the bugs are dying show both fungi. At the close of the season I hope to present a full report of the laboratory investigations, which the brief monthly reports offer no space for. Professor S. A. Forbes, the eminent State entomologist of Illinois, who has experimented in his laboratory on the development of parasitic fungi in insects, and who early noted the bacterial disease of the clinch bugs, visited my laboratory last week. He expressed the hope that a series of field experiments, such as are now being carried on in Kansas, could be conducted in Illinois.

"In closing, I may say that the outcome of the work so far this year is highly encouraging."

"Since making this report the requests for infected bugs have grown much less numerous. The laboratory experiments have been carried on with more attention paid to bacteria. So far I have been unable to successfully infect bugs in the laboratory from pure cultures of *Sporotrichum*. The *Sporotrichum* grows readily on a medium composed of beef broth and Irish moss, and pure cultures are easily obtained. Other experiments with these cultures are necessary, however, to make this statement positive. *Empusa* will not fruit on the plates. It behaves very peculiarly. Long erect filaments are sent out strikingly different from the customary hyphæ, but no spores are produced. As regards the bacteria, I am assured that the forms in my cultures are identical with Burrill's *Micrococcus insectorum*, two slides of which have been furnished me by Professor Forbes. This *Micrococcus* is found almost without exception in bugs which have died in the field and been sent in for examination. Another Micrococcus, larger and almost perfectly circular in optical plane, is often present in dead and dying bugs. Spraying experiments with fluids containing this Micrococcus give no successful results in infection." (Insect Life, Vol. IV, pp. 69-71.)

Fertilizers *versus* insects.

Gas lime and lime have long been recommended against root-feeding insects, and in a recent Bulletin of the new Jersey Agricultural College Experiment Station, Mr. J. B. Smith advocates kainit and muriate of potash for a similar purpose. Mr. Smith writes—

"The use of commercial fertilizers is becoming more general each year, and each year the farmers are considering more closely what material to buy to obtain the best results on their own land, and also the form in which the needed element is to be applied. Wherever it can be profitably done, potash should be applied in the form of kainit, and nitrogen in the form of nitrate of soda. I am not recommending these substances as in all cases the best fertilizers, nor would I be understood as condemning other forms of these elements. From the standpoint of the entomologist they are the best, because they have undoubted insecticide properties............During the season of 1890 I found in a fine peach orchard several trees undoubtedly infested by root lice. I directed the application of kainit in a trench, and the new foliage was normal. A neighbour, observing the process, doctored some of his own trees, improving the treatment by adding nitrate of soda, one quart of each per tree. The result was striking, showing that the nitrate had acted as a stimulant, and had probably also aided in the destruction of the aphids .... Potash is a necessary element of food for corn, and if, in supplying the potash, kainit be used, injury will be almost entirely prevented. Muriate of potash is also effective, but less so than kainit. The evidence of all the farmers now using kainit for corn, and with whom I have talked

on the subject, is to the one purpose—since they have used the potash salts the corn has been practically exempt from injury by cut-worms or wire-worms. That kainit will kill even true wire-worms (Elater larvæ) I have proved experimentally. It does not act very promptly, but it does kill eventually, as the following proves :—

"A large number of wire-worms were divided into two lots, nearly equal in number and similar as to size, and each lot was put into a large jar with about six inches of soil. A potato, cut into quarters, was put into each jar, just beneath the surface and close to the edge, to facilitate observation. Into one jar was put two ounces of clean water; into the other an equal amount, in which kainit at the rate of one ounce to one pint had been dissolved. No other treatment was given. For a week there seemed no difference, and most of the larvæ were buried in the potatoes. Then the younger larvæ in the kainit jar began to die, and in two weeks scarcely a living larva was to be found. In the other jar the larvæ lived on for more than a month without either food or attention, and they were then thrown into alcohol as specimens. Therefore I advise the application of kainit as a top-dressing, just as soon as the ground is ready to receive it, and as long as possible before planting."

The following is added as a foot-note :—

"Bulletin No. 33 of the Cornell station has come into my hands since this bulletin was sent to the printer. In it Professor Comstock reports poor success in laboratory experiments with kainit as against wire-worms. Space is lacking here to go into details; but I will do so in the Annual Report. That laboratory experiments do not always indicate what will happen in the field, the following will show :—

"On the Voorhees farm, in Somerset county, a fourteen acre field was divided into two sections, to test kainit and muriate of potash as fertilizers, and a strip of seven rows was left untreated between. The land was known to be badly infested by wire-worms and cut-worms or grub-worms, more specially one low meadow. In the half treated with kainit, the corn all came up well, and was not molested by insects at all; on the muriate half the injury was much lessened, and in the untreated rows, running the full length of the field, almost the whole was destroyed by the insects. The experiment was not made to test insecticide effect; but the results were so apparent that Mr. Voorhees spoke of them at once, and reports that since using kainit he has no further trouble with either wire-worms or cut-worms. This has also been the experience of his neighbours, and of all who have been questioned by me. I therefore again repeat my advice,—use kainit wherever practicable."

Prevention of insect ravages in England.

An interesting report on "Methods of preventing and checking the attacks of insects and fungi" (John Murray, 1891), by Mr. Charles Whitehead, has recently been published in England.

The methods recommended are generally such as are already well known in the United States, where so much has been done to develope this branch of agricultural knowledge, but Mr. Whitehead's practical little pamphlet will be useful for reference, not only in England, but also in India, where people are only beginning to appreciate the importance of utilizing the latest discoveries in the methods of combating the various pests that attack crops.

For checking *wire* worms and *Tipulidæ* larvæ, which are often very

destructive to the roots of clover and other crops in England, Mr. Whitehead recommends ploughing gas lime into the land when the crop is off the ground, while soot, guano, nitrate of soda, salt, and rape dust are all recommended as top-dressings to the plants.

Emulsions of kerosine and soap are recommended for spraying plants attacked by the onion fly, the celery fly, and the carrot fly, also for the destruction of aphids of all kinds, including the corn aphid and the hop aphid. Washes made of soap and extract of quassia chips are also recommended in many cases for the same purposes as kerosine and soap emulsion. With the hop aphid in particular this system of treatment seems to have been largely adopted, and a great many machines for applying it have been invented.

For the *mite* which attacks currant bushes, washing the bushes with compounds of soft soap and sulphur is recommended ; a compound of soap and sulphur, sold ready prepared for the purpose by Messrs. Burford of Chiswick, being particularly noticed.[1]

For the turnip beetle, dressing the plants with lime, soot, guano, and kerosine emulsion are all recommended.

Hellebore in powder or solution destroys saw fly which attacks gooseberry bushes, but care in handling it is insisted upon, as it is very poisonous.

Spraying with such arsenical washes as London purple and Paris green, is recommended for the destruction of the numerous caterpillars which defoliate fruit trees, though this treatment does not appear as yet to have been very widely adopted in England, as there is a prejudice against it on account of the poisonous nature of arsenical insecticides.

In the case of the caterpillars of the winter moth, the codlin moth, and the apple-bud weevil, protruding rims of tin or bands of sticky or impenetrable substances are recommended for fixing round the trunks of the trees to prevent the insects climbing up to lay their eggs, while white-washing the trunks and branches of fruit trees in the autumn, is also said to be useful, as it destroys the lichen and dislodges many insects which would otherwise find shelter either for themselves or for their eggs in the bark.

In the case of the *Phylloxera* of the vine, flooding the vineyards, injecting bisulphide of carbon into the ground close to the vines, and introducing American vines, which are not so subject to attack, are quoted as having been largely adopted in France.

For distributing insecticides a large number of machines are described, very many of them no doubt excellently adapted for the purposes for which they have been designed. About the two most generally useful

[1] This preparation would probably be useful against red spider on tea.

ones seem to be the "*Strawsonizer*" for distributing applications over fields and other large areas, and M. Vermorel's Éclair Knapsack pump (price about thirty-five shillings) for handwork.

Of the applications useful for the destruction of the fungoid diseases to which plants are subject, sulphate of copper washes seem to be the most generally useful. They are recommended for spraying over the plants in the cases of the potato fungus, the onion mildew, the apple scab, and the *Peronospora* of the vine, and for steeping the seed in the case of *Smut* and *Bunt* in wheat. Powdered sulphur also is recommended against Hop mildew, while freshly burnt quicklime and sulphur, also sulphate of iron, have been found useful in the case of the onion mildew, for which also sulphate of copper is recommended.

INDIAN MUSEUM, CALCUTTA,
29th February 1892.

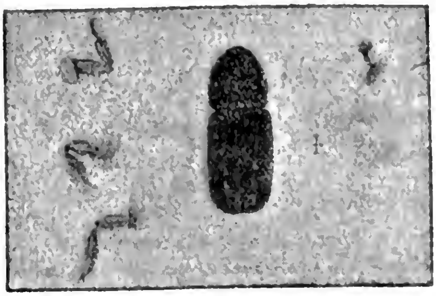
NOTES ON SCOLYTIDÆ.

By W. F. H. Blandford, F.E.S., F.Z.S.

[1] *Pityogenes scitus n. sp.*

This species is new to science: it is very closely allied to the European *Tomicus* (or *Pityogenes*) *chalcographus*, from which it can be separated only by careful comparison.

Pityogenes.—Bedel. Faune des coléoptères du bassin de la Seine. VI, p. 388. A genus formed to contain those species of *Tomicus* (as limited by Eichhoff, etc.) in which the prosternum has no intercoxal process, the anterior tibiæ are sublinear, and the apical depression of the Elytra is impunctate. The type is *P. chalcographus.*



P. scitus sp. nov. Mihi.—Sub-elongatus, nitidus, sub-glaber, nigropiceus, antennis et pedibus ferrugineis; elytris ferrugineo-testaceis, basi et margine laterali (et apice in maribus sat maturis) infuscatis; thorace ante medium lateraliter coarctato, post medium impresso, antice fortiter exasperato, postice punctis fortibus, sparsisque notato, linea sub-elevata et plaga laterali laevibus; elytris tenuissime striato-punctatis, punctis versus apicem obsoletis, prope suturam profunde impressis et dentibus tribus in utroque depressionis latere armatis.

Long.; 1·7—2 mm.

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[1] This insect was originally sent to the Indian Museum, as attacking the *Shorea assamica* tree in Sibsagar, Assam (see Volume I, p. 42 of this serial). On Mr. Blandford's noticing, however, that other species of *Tomicus* and *Pityogenes*, in the modern limits of these genera, are only to be found in conifers, some small pieces of stick that were originally forwarded with the insects, were sent to the Royal Botanical Gardens, Sibpore, for further examination. Here they were kindly looked at by Dr. George King, who found that they do not belong to the *Shorea assamica* tree, but possibly to *Pinus khasya*, the sticks, however, not being sufficient for precise identification. The tree therefore that is attacked by *Pityogenes scitus* Bland., though not definitely ascertained, is no doubt one of the conifers. The figure shows the imago dorsal view, also much enlarged diagrams of the legs and antenna. The actual size of the insect is shown by the hair line.

Mas. Fronte convexa, rugulose punctata, linea media sub-elevata; dentibus elytrorum validis. *Femina.* Fronte plana, tenuissime granulata, foveam profundam in vertice exhibente, non-nunquam supra os lateraliter impressa; dentibus elytrorum ad tubercula setigera reductis.

Hab.: *Doubtful.*

This species closely resembles *P. chalcographus*, but differs in the following points:—

The forehead in the female has three strong foveæ with a central space raised, smooth and dull, whereas in *P. chalcographus* the fovea is single and is much nearer the mouth, and the lateral foveæ do not occur.

The prothorax is generally similar to that of *P. chalcographus*, except that it is very slightly narrower anteriorly; the punctures on the posterior half are stronger, closer, and more rugose.

The interspaces are filled with excessively fine punctures, only visible under a high power, and much closer than the similar scattered punctures in *P. chalcographus*.

The elytra in the male are testaceous, strongly infuscate along the lateral margin, and for the whole of the apical declivity they are slightly narrower and flatter, the apical depression is shorter and more vertical, and the teeth are situated farther back, and closer to each other, and the anterior pair point directly backward instead of obliquely upwards, and their base is longer.

In the female the elytra are more testaceous yellow (in spirit specimens), sometimes with a distinct dark lateral border; they are slightly flatter and less shining, and the rows of punctures are not so distinct and regular as in *P. chalcographus.* Antennæ and legs as in the latter species.

[1] *Platydactylus sex-spinosus Motsch.*

This insect was first described from Ceylon by Motschoulsky as *Eccoptopterus sex-spinosus*; Eichhoff then described it independently as *Xyleborus abnormis*, and subsequently noted its identity with Motschoulsky's species, pointing out that the latter genus was bad and founded on untenable characters, and ignoring Motschoulsky's specific name. In 1886 he founded a new genus *Platydactylus*, for *P. gracilipes* from the Moluccas, and then suggested that his *Xyleborus abnormis* may belong to this genus This I find to be correct. I prefer to retain Motschoul-

[1] Noticed in vol. I, p. 61, of this serial as destroying paddy (*Oryza sativa*) in Lower Burma by boring into the stalks.

Mr. Blandford writes that the male will probably prove to be smaller in size and somewhat different in structure from the female.

sky's specific name, as it has priority, and Eichhoff's is inappropriate when the insect is no longer retained as a Xyleborus.

Platydactylus.—Eichhoff. Notes from the Leyden Museum, VIII (1886), p. 25.

Head globose, sunk in thorax. Antennæ with five-jointed funiculus, and sub-tunicate club. Prothorax scabrous in front, without basal border. Tibiæ strongly flattened, spatulate, finely serrate externally, and grooved for reception of the tarsi. Three basal joints of hinder tarsi broad and flattened, somewhat trigonate.

The form of the hinder tarsi will distinguish this genus from any other Tomicidæ.

Platydactylus sex-spinosus.—Motschoulsky. Bull. de la Soc. des Naturalistes de Moscow, 1863, I, p. 515 (*Eccoptopterus sex-spinosus*) *Xyleborus abnormis* Eichhoff, Berl. Ent. Zeit., 1868, p. 282. Ratio Tomicinorum, p. 343.

Oblong, moderately shining, pitchy-black with gray pubescence. Head large and globose, forehead closely punctured and pubescent above mouth.

Thorax nearly globose, broader than long, base truncate, posterior angles rounded, sides and apex rounded, the latter strongly; above very convex with an obscure transverse elevation behind middle of disc, thinly pubescent with transverse rows of asperities in front, behind smooth, dull, appearing finely alutaceous under a high power, with scattered punctures.

Elytra narrower than thorax, one-third longer, narrowed from base to apex, base truncate, shoulders and sides rounded; above convex at base, thence sloped to apex forming an oblique depressed surface beginning before the middle of the elytra; closely and irregularly punctured, the punctures being coarser in the apical depression, which is lighter in colour, and the sides of which are each armed with three strong pointed spines. The upper one is the largest and placed about the middle of the elytra, the lower the smallest are close to the apex.

Anterior and middle coxæ and femora testaceous, tibiæ and tarsi pitchy; posterior legs pitchy except last tarsal joint. Joints of the posterior tarsi oblong, flattened; first joint larger than second or third joints.

Length, 2·5 mm.

Habitat: Ceylon, Burma.

NOTES ON COCOANUT PALM COCCIDÆ.

By W. M. Maskell, F.R.M.S.

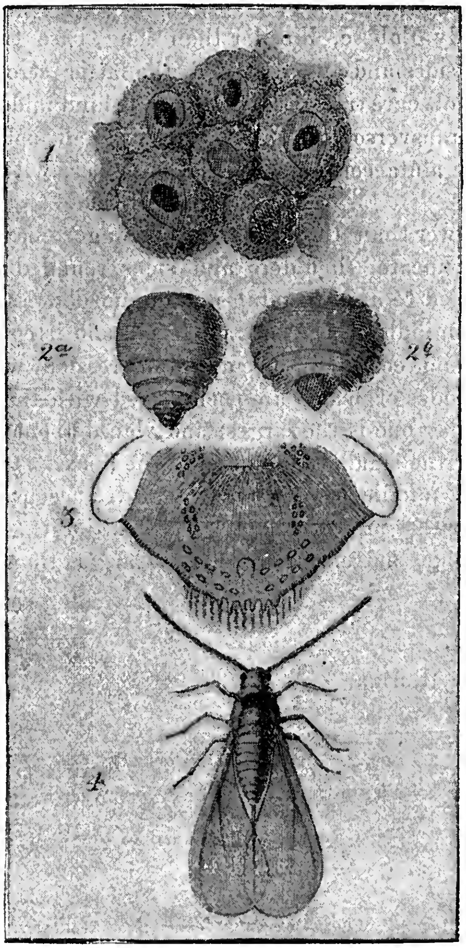
[The following insects attack cocoanut palms in the Laccadive Islands. For further particulars see page 7.—Ed.]

Dactylopius cocotis Maskell.

Transactions N. Z. Institute, 1889, Volume XXII, p. 149.

A variety of this species occurs on cocoanut palms in the Laccadive Islands, India. The differences from the type which inhabits Fiji are as follows :—The Indian insect is scarcely red in colour, inclining rather to yellow, and the antennæ have (at least frequently) only seven joints. The first point is very unimportant, and as to the second there are at present known six or seven species of Dactylopius in which the antennal joints vary from seven to eight. The marginal tufts of small hairs, the characters of the feet, the form of the larva, and other features, are similar in both Indian and Fijian specimens, and they may therefore be properly considered as specifically identical.

Aspidiotus destructor Signoret.



Essai sur les Cochenilles, p. 94: Annales de la Société entomologique de France, 1868, p. 120. Figs. 1—4.

Female puparium really round and white in colour, but being aggregated in masses on the leaf with very numerous yellow pellicles and much dust and fluff: the general appearance of the mass is brownish yellow: the secreted portion of the puparium is very thin, delicate and translucent: pellicles central, yellow, transparent.

Male puparium similar to that of the female and aggregated with it in the general mass, so that it is difficult to indicate any particular features, except of course that only a single pellicle is visible in it, the female puparium having as usual two.

Adult females yellow, darkening with age; length about one-fiftieth of an inch pegtop-shaped, shrivelling at gestation. Abdomen ending in six lobes, of which the two median are shorter and smaller than the next lobe at each side of them: between the lobes and for a short distance beyond on the margin, are a number of scaly serrated and forked hairs: four groups of spinnerets with from eight to ten orifices in each: many single dorsal spinnerets. The rostral setæ appear to be often excessively long.

Adult male brownish yellow, very small and delicate: length about one-sixtieth of an inch. Form normal. Antennæ of ten joints. The anal spike is rather long.

Habitat—on cocoanut, date, and other palm trees, and on *Goyaeries psidium*: Isle de la Réunion and Laccadive Islands, and probably elsewhere in the tropics. Dr. Signoret states that about 1868 the cocoanuts of Réunion were "threatened with total destruction" by this insect.

The proportionate smallness of the two median abdominal lobes in the female is a distinguishing character of the species. Dr. Signoret was not able to find a male amongst the specimens sent to him.

From the folded and closely pressed form of the cocoanut leaves which I have seen, I should imagine that it would be far from easy to proceed against *A. destructor* by ordinary methods of spraying: but I am not sufficiently acquainted with the habit of the trees to express a decided opinion, and there may possibly be facilities for other remedial measures.

Description of Figure.—1, aggregation of male and female puparia, male with one pellicle, female with two (the insects are removed); 2, adult females, *a* before gestation, *b* after gestation; 3, Pygidium of female (after Signoret); 4, adult male.

THE SILK-COTTON POD MOTH.

By F. Moore, F.Z.S.

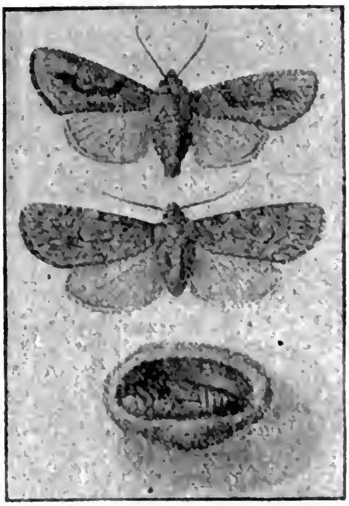
[This insect was reared in the Museum from silk-cotton pods furnished by Mr. R. Blechynden of the Agri-Horticultural Society. The pods were found to be tunnelled by the caterpillars. They were received in the latter part of the cold weather, about the time that the silk-cotton pods ripen in Calcutta. Mr. Blechynden noticed that the crows paid a good deal of attention to the fallen pods, no doubt with a view of devouring the caterpillars they contained, and the extraordinary speed with which the caterpillars tunnelled into the earth when the pods were opened shows that they appreciate the fact that the crows are on the look-out to eat them up. The caterpillars constructed for themselves typical noctues cells of earth in the ground, for the protection of the pupæ, and the moths emerged in the following March, when the silk-cotton trees (? *Bombax malabaricum*) were in flower on the Calcutta Maidan. The insect therefore passes through but one generation in the year, and probably lays its eggs in the flowers or immature pods of the silk-cotton tree. The figure shows the male and female moths, and the pupa lying in the earthen cell that the caterpillar makes in the ground; all natural size.—Ed.]

Family Hadenidæ.

Genus Nov. Mudaria—Male.—Forewing elongata, narrow, apex rounded, exterior margin oblique and slightly convex; cilia scalloped; cell long, more than half the length of wing; first sub-costal branch emitted at three-fifths before end of the cell, second branch from close to end of cell; third from end of cell, trifid, the sixth (or upper radial) also from end of cell; discocellular very slender, outwardly recurved, the radial from near its lower end; two upper median branches from angles at lower end of the cell, the lower median at three-fifths before end of the cell; sub-median vein recurved. *Hind-wing* moderately short, apex rounded, exterior margin slightly convex, and very slightly scalloped; cell extending to half the length, broad; sub-costal vein curved near its base and touching the costal; two sub-costal branches emitted from end of the cell; discocellular outwardly oblique, radial from near its lower end; two upper median branches from a footstalk a little beyond end of the cell, lower median at about one-third before end of the cell; sub-median and internal vein straight. *Body* stout, abdomen extending beyond hind-wings, compactly scaled, thorax sub-crested at posterior end. *Antennæ* thick, whip-shaped; *head* prominent, the front furnished with a broad flat centrally-pointed black hard corneous piece, which projects slightly but visibly beyond the scales. *Palpi* short stout, porrect, not reaching the front, compactly squamose, third joint short, cylindrical, narrower than lower joints. *Legs* stout; fore-legs short; femora thickly clothed with long hairy scales; hind tibia with two pairs of prominent spurs. *Female.*—Antennæ as in male. Frontal corneous piece broader and projecting more prominently beyond the

scales. Palpi longer, extending beyond the front; third joint longer than in the male; legs similarly clothed.

Mudaria cornifrons.—Male. Upper side. *Fore-wing* ferruginous-gray, with numerous minute blackish scales; crossed by four black lines, each line being dilated at the costal end; the first line basal, sinuous, duplex, but indistinctly defined; the second line sub-basal, irregularly zigzag, duplex, the exterior being most prominent; the third line discal, recurved, sinuous, duplex, the points upon the veins, the interior line being most prominent; the fourth line sub-marginal, lanceolated, the points upon the veins; between the sub-basal and the discal line is a large, broad, longitudinally disposed, irregular constricted black lined mark, which extends above and below the cell; marginal cilial line with slightly defined black lunules; cilia slightly interlined with black. *Hind-wing* white, with a slender black marginal lunular line. *Body* dusky grey above, paler grey beneath; palpi and legs, dusky grey; antennæ dusky brown; front piece corneous, shining jet-black; proboscis long; tarsi with pale bands. Under side.—*Fore-wing* greyish-white, glossy; costal border and the exterior half slightly speckled with minute blackish scales. *Hind-wing* with the costal and apical borders also slightly speckled with similar blackish scales; a small slightly defined black speckled spot on middle of the discocellular veinlet.



Female.—Upper side. *Fore-wing* paler, more uniformly grey; speckled with black scales; transverse lines and the intermediate constricted mark as in the male; the posterior border and interspace between this mark and the sub-basal and discal line is, in some specimens only, thickly black speckled. *Hind-wing* very slightly grey, speckled along the costal

border, and with a few black scales disposed upon the lower sub-basal and the median veins, thus forming a series of incipient discal spots; marginal line blackish. Under side as in the male. *Body* palpi, and legs grey; tibia and tarsi with dusky grey bands; the jet-black corneous front-piece larger, broader, and more prominently projected than in male. Expanse of wings; ♂ $1\frac{5}{8}$, ♀ $1\frac{3}{8}$ to $1\frac{5}{8}$ inch.

Habitat—Calcutta.

A NEW GALL-MAKING APHID.

By G. B. Buckton, F.R.S.

(The galls, from which these insects were obtained, were furnished by Mr. C. F. Elliot, who found them on what was thought to be a variety of the *Pistacia terebinthus*, tree with aromatic leaves something the shape of those of the lilac. The trees were found in November 1891, growing in a forest in the dry bed of a broad stony ravine about 3,000 feet above sea-level, near Harnai, on the Sind-Peshin section of the North-Western Railway, Baluchistan. Almost every tree had a dozen or more of these galls towards the extremities of the branches. The galls were of every shape; some empty, some opening, and the flies swarming out; some still with the young insects closed up inside. The figure shows the winged insect with diagrams of its antenna and legs. The size of the specimens is indicated by hair lines. The gall which is also shown is half the actual size.—Ed.)

Late in December 1891, I received from the Indian Museum several pod-like vegetable excrescences, concerning which I have pleasure in making the following report:

These galls were of various sizes, some of them measuring as much as 4·5 inches or 11·5 centimetres in length, whilst others did not exceed the size of a small walnut. In width they were about 3·0 centimetres. The larger kinds had somewhat the appearance of contorted figs, more or less compressed and indented; but probably they were more cylindrical in form when fresh and green. Their prevailing colour was ferruginous-yellow or reddish, shading into yellow and greener tints. The surfaces were furrowed longitudinally with shallow streaks, with here and there small tears of resin of a turpentine consistence and odour.

The gall-like bodies seem to be formed directly from the leaf stalks of the trees, and not from the leaves. Whilst some of these excrescences were pyriform, others had a singular contorted shape and were twisted like a cork-screw. The galls terminate at their summits in a horny point, which in the five specimens examined were imperforate.

When cut across, they showed hard and woody walls, varying in thickness from that of card-board to the thickness of pasteboard of perhaps 1·5 millimetres. Each had but a single cavity, without partitions; and in some cases the outer walls were perforated by one or two small round holes about the size of a large shot.

In the largest specimen, a rent was found from which the winged insect had chiefly escaped.

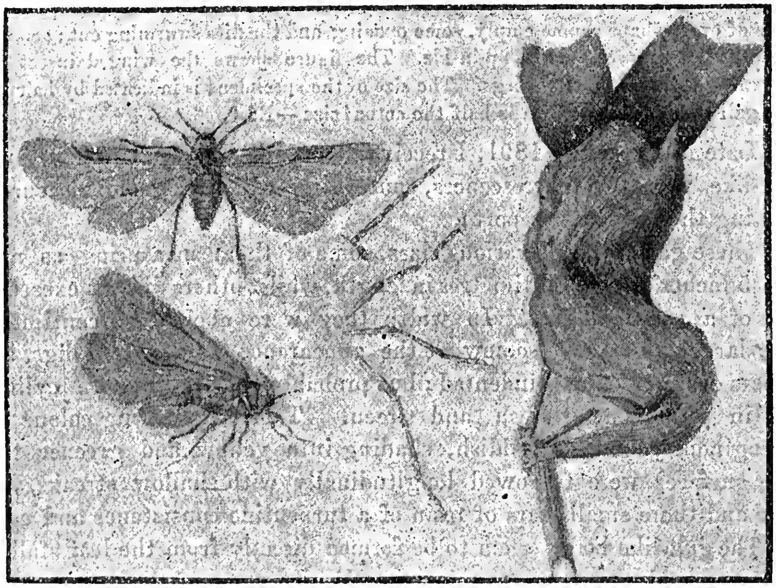
The contents of these chambers consisted of a *débris* of dead insects, winged and apterous, mixed up with a quantity of fibrous substance and excrementatious matter almost insoluble in water. To the naked eye the mass was of a greenish-grey, mixed up with wings and legs forming a tangled heap.

The microscope showed these insects to belong to the Aphidinæ,

and to the group of Pemphiginæ, which are known to produce pseudo-galls by setting up irritation on the leaves or bark of various trees.

As this Pemphigus differ in several respects from any hitherto described from Europe or America, I add a diagnosis of the winged female, remarking that some Indian entomologist may usefully describe the colours, if they show such, from living specimens.

Pemphigus edificator, Buckton.



Imago, wholly black. Head small, furnished with normally formed eyes and the usual supplementary eyelet antennæ about half the length of the body, seven jointed, counting the terminal process as a joint. Third and sixth joints the longest, and apparently not tuberculated. Notum and pronotum broad. Abdomen ringed and tapering to a rounded cauda. Nectaries not visible. Legs black; the hinder pair hirsute. Tarsus, two-jointed with claws. Upper wings about twice the length of the body and normally folded. Costal edge strong, with a broad black cubital vein, ending beyond the middle of the costa with a broadly banded black stigma, having an internal dark cell. Stigmatic vein long and curved. Second vein short and disconnected from the cubitus, like that of Schizoneura. Third vein joined to the cubitus, and widely forked close to its insertion.

Lower wing small and delicate; with a cubitus twice forked, and complete to the margin.

Mr. Elliot found these pod-like galls on the twigs of Pistacia grow-

ing in the dry bed of a broad stony ravine about 3,000 feet above sea-level near Harnai in the Sind-Peshin section of the North-Western Railway. "Almost every tree had a dozen or more of these galls towards the extremities of the branches. They were in every stage; some empty, some opening, and the flies swarming out"; some still with the immature insects enclosed.

The galls which I examined in December contained only a few pupæ and larvæ. The grey mass before noted is nearly insoluble in water, but nevertheless it had a soapy flavour on the tongue.

Two of the excrescences contained also the caterpillar of some lepidopterous insect, each entangled in its own web.

They were quite lively and fat, about three-quarters of an inch long, and did not appear famished, although they cannot have eaten green food for many previous weeks. It is not very likely that they consumed the aphidis imprisoned in the galls.

In conclusion, I may note that the European *Pemphigus cornicularius* of Passerini constructs a long bean-shaped gall with a pointed top. It has been figured by M. L. Courchet in "Etude sur les Galles produites par les Aphidiens," Montpellier 1879, see part 1, figure 4. He says this structure does not exceed in size that of a haricot-bean. Figures also are given in this same memoir of the antinnæ and the wings. In all these particulars *P. cornicularius* differs from the Indian *Pemphigus*, although both feed on different species of Pistacia, and have a close affinity.

HASLEMERE.

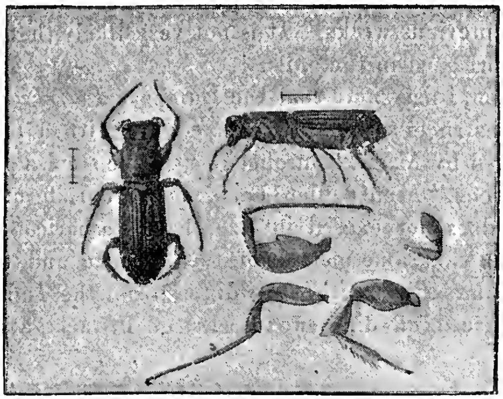
16 January 1892.

A NEW WOOD BORER.

By Oliver E. Janson, F.E.S.

[The specimens from which this species is described were said to have been found attacking oak stumps in Deoband, North-Western Provinces, in December 1881. They are referred to the Coleopterous Family Scolytidæ, sub-Family Platypides.—Ed.]

Diapus, impressus n. sp.—Rufo-brunneus, elytris flavo-testaceis, apice rufo-brunneis, antennis pedibusque flavis. Capite parce punctato, vertice tri-carinato, carinis nitidis, prothorace oblongo, lateribus emarginatis, elytris subtiliter punctato-striatis, interstitiis duabus suturalibus magis elevatis. Long. 3½—4 millimetres.



♂ Clypeo utrinque profunde impresso, elytris apice truncatis inermis.
♀ Clypeo punctato, elytris apice quinque-spinosis.
Deoband, North-Western Provinces, India.

Red-brown, shining, basal margin of the thorax and the elytra brownish yellow, apical portion of the latter red-brown; legs and antennæ pale yellow; the knees brownish. Head dull, sparsely punctured, three carinæ on the vertex, and one on each side behind the eyes shining; the clypeus, in the male, occupied by two large deep impressions separated by a narrow median carina and margined at the base by an obtuse bi-sinuous carina; in the female sub-convex, coarsely punctured, with a feeble median carina; antennæ with the scape broadly pyriform. Thorax oblong, strongly emarginate at the sides before the middle, the basal margin bi-sinuous, a row of hirsute punctures close to the anterior margin, the base finely and closely punctured and with a slight median line. Elytra punctate-striate, the second stria from the suture and the outer marginal one broader and more strongly punctured, the first and second interstices from the suture strongly raised, the fourth slightly convex; the apex coarsely punctured, sub-truncate and unarmed in the

male, in the female with five acute apical spines. Abdomen densely pubescent at the apex in the male, in the female concave and rugulose. Anterior tibiæ crenulate on the outer side, the tarsi very slender and longer than the femora and tibiæ together. Posterior tibiæ triangular, the first joint of the tarsi rather longer than the tibiæ, broad, flattened, and ciliate, the remaining joints slender and together about half the length of the first.

Most nearly allied to *D. molossus* Chap. (Mon. Platypides, p. 333), but in the male of that species (the only sex described) the clypeus is densely pubescent and without impressions, the scape of the antennæ is linear instead of pyriform, and the elytra have the interstices punctured and are uni-colorous, it is also rather smaller than the present species. The armature at the apex of the elytra of the female is very similar to *D. quinque-spinosus* Chap.

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THE LOCUST INVASION OF 1889—92.

Contents.

In the early part of 1891 a report was issued on the subject of the migratory locust *Acridium peregrinum* Oliv. which has recently invaded India. This report gave a summary of the information obtained up to the beginning of December 1890. The notes since collected on the subject of the invasion of Northern Africa, Persia and Turkish Arabia by the same insect, appeared in Vol. III, No. 1, of these *Notes*, where details are also given of what has been ascertained on the subject of the parasites and natural enemies which attack it in India. In the present report it is proposed to give a short sketch of the general features of the invasion in India, together with such fresh information as has been obtained on the subject of the habits of the insect and the methods adopted for dealing with it.

The history of the invasion in India.

The locusts were first noticed in June 1889, when flights were reported from Sind and Western Rajputana. These flights no doubt originated in the sand-hills of the desert, where the insect is said to breed each year in larger or smaller numbers. They began laying their eggs as usual in June, when the rains of the south-west monsoon broke. During the remainder of the rainy season of 1889 the flights gradually spread throughout Eastern Rajputana, the Punjab, and Sind, egg-laying going on at intervals in various parts of Rajputana and the Punjab. The young locusts which were born from the eggs laid in the beginning of the rains, acquired wings towards the latter part or August. In the beginning of the cold weather, owing to the extensive breeding which had taken place, the locusts seem to have become very numerous in Rajputana and the Punjab, and in November and December flights from these areas found their way throughout the North-West Provinces and Central India, and penetrated even as far as the Vizagapatam, Kistna and Godavari Districts in the Madras Presidency. They were also reported from British Baluchistan. During January and February 1890 stray flights were reported from various parts of India, but the cold seems to have told upon them, and they were not very active. As the hot weather of 1890 approached, however, and the soil, moistened by the winter rain, began to grow warm, the locusts again became active and commenced egg-laying. Eggs were layed throughout the north-western districts of the Punjab in March; also in the Shikarpur District of Sind in April. By June the young locusts hatched from these eggs had acquired wings, and the flights spread in all directions. They penetrated throughout the

whole of the North-West Provinces, besides overrunning Sind and Rajputana, and making their way into Kathiawar. Eggs were laid towards the latter part of June 1890, when the rains had well started, throughout the whole of Western Rajputana, and in the Gurgaon District of the Punjab. The young locusts hatched out in countless numbers in July, and in the case of Western Rajputana they were reported as doing much damage in August. During August and September the flights that were still wandering about, laid more eggs in parts of the Punjab. About September the young locusts, that had been born in the beginning of the rains, seem to have acquired wings, and from September, on through the cold weather of 1890-91, the flights spread in all directions in the most remarkable manner. They made their way throughout Sind, Punjab and the North-West Provinces. Vast flights also moved through Central India into the Central Provinces, and thence eastwards into Bengal and Assam, southwards through Berar and Hyderabad into the Madras Presidency, and westwards into the Bombay Deccan. The flights did a good deal of injury in the restricted areas where they settled, but the people were so industrious in driving them off their crops, and the birds destroyed such large numbers, that the damage inflicted was small considering the vastness of the invasion. Through December, January and February, flights were still reported from all parts of India, but the cold and damp, combined with the relentless persecution of the birds and the people, had thinned their numbers and reduced them to so miserable a state that they were able to do little or no damage.

In March 1891 some of the locusts obtained from the flight which passed over Calcutta in November 1890 began to lay eggs in their cages in the Indian Museum. About the same time, owing no doubt to the increasing warmth at the close of the winter rains, the flights in the Punjab became more active, and egg-laying took place at first in the north-west of the Punjab and Sind, and afterwards in Baluchistan. In May the young locusts hatched from these eggs became extremely numerous in the Punjab.

The rabi crops were generally too far advanced in growth to be much damaged by them, but the extra rabi and the early sown kharif crops—especially cotton—suffered severely. The grass in some tracts was completely eaten down, and almost every bush and tree was stripped of its leaves. Some idea may be formed of the numbers in which the insects appeared, from the fact that railway trains were said to have often found it difficult to proceed, owing to the rails being made slippery by the crushed bodies of the young locusts. A regular warfare was waged against the insects, under the leadership of the district officials, who organized the people for the purpose of collecting the eggs and

destroying the young locusts systematically. The military also rendered useful service in destroying the swarms that invaded cantonments.

The method that was most generally adopted was that of driving the young locusts into trenches, but the Cyprus screens described in the previous report were also used to a small extent, and useful work was done by driving the young into heaps of straw and bushes which were then set on fire. In this way many thousands of maunds of young locusts were destroyed, and the actual crops were in many places protected. The numbers of the locusts, however, that bred in waste places in the Punjab was so enormous that success was only partial, and vast hordes became full grown and acquired wings. Towards the latter part of May large flights of these young locusts began to pass over Central India and the North-West Provinces into the Central Provinces and Bengal, at the same time penetrating into Kathiawar. During the months of June, July and August, these flights seem to have flown about from district to district, descending at intervals to devour the young khárif crops and doing a good deal of damage over restricted areas, especially in Bengal. They did not lay any eggs, however, and little was heard of them after August, the supposition being that by this time they had been pretty completely destroyed by the birds and unfavourable climatic condition of the damp regions into which they had penetrated.

The immediate result of the departure of these flights seems to have been to clear the Punjab of locusts, but the insect was still prevalent in Sind and Rajputana, and soon after the commencement of the rains of the south-west monsoon, flights began to be again reported from the Punjab. During the rainy season of 1891, egg-laying went on as usual in Sind and Rajputana, while in the Punjab, eggs were reported in comparatively small numbers, at first from the south-eastern districts, and afterwards throughout the whole area, thus pointing to the supposition that the eggs were laid by flights from Rajputana. Breeding seems to have gone on at intervals throughout the rainy season of 1891, young locusts being still reported in the Punjab Salt Range in November. But they were very much fewer than before, and the birds —especially the Rosy-pastor (*Pastor roseus*)—destroyed them in vast numbers. The locusts themselves also were so much parasitised and diseased that the work of the people in destroying them was very much lightened, and by the close of the year the pest seems to have been pretty completely wiped out.

In March 1892 a few locusts again appeared in Sind and the western frontier of the Punjab, and laid eggs in Dera Ismail Khan, while in May some stray flights penetrated into the North-West Provinces and

Bengal, little damage, however, has been reported, and the insects seem to have been too few to cause any anxiety.

Notes on the life history of the insects.

It will be remembered that the only important points in the life history of the insect on which any serious doubts were indicated in the previous report, were upon the subject of the number of generation in the year and the relationship borne by the young locusts which hatch out in the spring to those which hatch out in the autumn. An attempt has since been made to settle these points by rearing the insect upon a considerable scale in large cages which were specially constructed for the purpose in the Indian Museum. The cages were placed under somewhat different conditions of sunlight and moisture, but in each case the insects, though reared from the egg to the imago stage without difficulty, died off before any ovipositing took place.

Considerable quantities of eggs were received from Rawalpindi and Peshawar in the spring of 1891. The first sets dried up without hatching, in spite of the attempts that were made to keep them moist by watering the earth in which they were placed (1). Eggs received in the end of March, however, hatched out freely, though a large proportion are believed to have been destroyed by the parasitic flies that also emerged in large numbers(2). These young locusts were reared through all their stages without difficulty, though there was considerably greater mortality amongst them than had been the case with the ones that were reared in the Museum the previous year, and this in spite of the fact that the rearing cages were larger than before, and were kept, some in the Museum and others in the open air, with a view to testing the conditions most favourable to the development of the insect. The young locusts acquired wings by the middle of May, but died off so rapidly that there was hardly any of them left by the end of the month. It was not possible, therefore, to make any observations as to the time at which they would lay their eggs.

On the 19th June 1891, Captain C. G. Parsons wrote from Kohat, that up to a few days previously locusts had been obtainable in the western portion of the district in every phase of development from eggs to fully-winged insects. He concluded that the process of egg-hatching had continued from the beginning of April until the beginning of June in tracts of country where the difference in elevation caused only a slight change of climate. We have seen that the locusts that were hatched

(1) This would seem to indicate that breaking up the land to expose the eggs to the air would be useful, provided it were done soon after the eggs were laid. Later on ploughing up the land becomes almost useless as the eggs hatch out whether exposed to the air or not.

(2) Noticed more fully in No. 1 of this volume, pages 34 and 35.

from the earlier batches of eggs, acquired wings in May, but there is evidence to show that these young locusts were not the parents of the eggs found by Captain Parsons in the middle of June, and probably not of any of the eggs laid during the rains. The flights which overran the North-West Provinces and other parts of India during the rains of 1891 were composed, as we have seen, of the young locusts in question. Large numbers of specimens from these flights were sent to the Museum from various places, but the numerous females that were dissected, invariably had their ovaries far too undeveloped for egg-laying. It is clear, therefore, that these young locusts could not have been the parents of the later broods of eggs. The case of the locusts sent to the Museum from flights which visited Singbhoom in the end of June and beginning of July, has been recorded as a typical one. The first specimens from this district were received in the Museum on the 30th June. The females were found on dissection to have their ovaries in an altogether rudimentary condition. On 7th July a number of living specimens were forwarded from the same locality. These were carefully fed in a cage in the Museum, and from time to time a specimen was dissected; but up to the 7th of August, when the last specimen died and was dissected, though the growth which had taken place in the ova was very distinctly perceptible, yet there did not appear to be the slightest probability of the insects being ready to oviposit for a long time to come. The impossibility of keeping the locusts in a healthy condition in confinement makes it that deductions drawn from caged specimens must necessarily be unreliable. So far, however, as the evidence can be depended upon, it goes to show that the later broods are not the offspring of the young locusts hatched in the early part of the year. The question would be an easy one to solve for any one who lived on the borders of the deserts of Western Rajputana, where the insect is constantly to be found. All that would be necessary would be to dissect the insects present from day to day, and to trace the growth of the ovaries throughout the year. It may be suggested that the matter is one that might reasonably be taken up by some of the medical officers who are resident in the areas concerned.

With regard to the parentage of the eggs which are so often laid in the Punjab towards the close of the winter rains, it has been ascertained that eggs can be laid at this time by locusts which were themselves hatched in the preceding rains. Winged locusts from a flight which passed over Calcutta in November 1890, and which had almost certainly originated in eggs laid in Rajputana in the previous rains, were kept in a cage in the Museum and regularly fed. In the latter part of March 1891 they began copulating, and on the 26th March a number of eggs were laid. The earth in the cage had been previously saturated with water, in

imitation of the conditions that have been shown to be favourable to egg-laying, but the insects seemed to be too sickly to dig holes in the ground and simply deposited them on the surface. Some of the locusts lived on, after laying their eggs, through a great part of April, but by the 4th of May they were all found to have died, while the eggs they had laid dried up, and came to nothing. Very much the same experience is detailed by Colonel Powlett, Resident, Western Rajputana States, who writes in a report, dated 24th April 1891, received from the Agent to the Governor-General, Rajputana, through the Government of India :—

"At and about Jodhpore most of the young brood of locusts appeared early in August. When this brood got wings in September, I caught some hundreds and put them in cages and had them regularly fed; they died off, and by February there were less than twenty left, but two pairs of these were observed to copulate. On the 24th and 25th February two females laid eggs. They were not healthy masses of eggs, and the females did not succeed in depositing them under the soil placed in the cages, nor have they hatched. But it is evidently difficult to keep locusts healthy in cages, and the oviposits being poor is not wondered at. It would appear, however, to be proved that the common locusts of Northern India can copulate and lay eggs six or seven months after birth, and that in all probability the eggs lately laid in the Punjab were those of insects hatched last August. The locusts which copulated round Jodhpore last July were of a bright yellow; the survivors of their offspring, which were pink when put into the cages in September, were in February a dirty purple colour, and to the best of my recollection that was the colour of the locusts the eggs of which many years ago I helped to destroy during the month of March in the Punjab."

The habitual disappearance of locusts throughout the greater portion of the winter months in North-Western India is explained by the fact that they require little or no food during this period, and probably hybernate in a dormant condition. On 28th February 1891 Mr. J. Cleghorn wrote that locusts had been hybernating without food in a cage kept in his house in Peshin, Baluchistan, since the 15th September 1890, though he had found that similar insects in the summer required to be fed constantly to keep them alive.

Measures adopted against the locusts.

There is little to add to what has already been recorded upon the subject of the methods adopted in fighting the locusts, but it may be useful to notice what was actually done during the year 1891 in carrying on the campaign in different districts. The reports which have been received upon this subject are very fragmentary, but the measures they describe are probably typical of what went on over the greater portion of the areas invaded.(1)

(1) The following notices are mostly taken from a report by the Director of Land Records and Agriculture, Punjab, supplemented by the information collected from crop and other reports sent to the Museum.

In the cold weather of 1890-91 numbers of the winged locusts which swarmed into the Rawalpindi district were killed in the early mornings, when they were numb with cold, by the people; and as the spring of 1891 advanced, a regular campaign was organized throughout the Punjab by the district officials for the destruction of the young locusts.

In Dera Ismail Khan, a naib-tahsildar and kanungo, with six or seven chaprasis under them, were put in charge of each tappa, and lambardars and zaildars were warned to render every assistance in their power. Five hundred rupees were spent in rewards. The wells and water-courses were kept clean to avert epidemic disease, but the people were very apathetic, and little impression was made on the vast swarms which crowded into the district.

In Rawalpindi, the district was divided into circles with an officer in charge of each whose main duty it was to look after the destruction of the locusts and their eggs. All tahsil officials were employed in the work of destruction, and a thousand rupees were spent from district funds. Millions of eggs and young locusts were destroyed, but the impression made was small, as the insects laid their eggs largely in the extensive and sparsely peopled Kala Chitta Range, where it was most difficult to get at them.

In Hazara some four hundred maunds of young locusts were destroyed in April in the Mansahra Tahsil under the direction of the tahsildar.

In Peshawar the villagers were turned out at once whenever young locusts showed themselves, and by the 20th April some ten thousand people were at work. When the rabi harvest began the villagers were dismissed, and five thousand hired labourers were employed until about the 3rd of May, when the barley was half reaped and the ears of wheat were too hard to be attacked by the young locusts. At a low estimate, over eighty millions of young locusts were destroyed, the cost being about eight thousand rupees. The myriads of locusts, however, which poured into the district from independent territory made it impossible to deal at all completely with the invasion.

In Kohat orders were issued to turn out the people when the locusts hatched, and the greatest exertions were made to deal with the pest. In the Kohat station itself, Captain Parsons wrote that the chief invasion lasted about ten days. During this time vast numbers of locusts were destroyed each day, the quantity amounting on one occasion to six hundred maunds. One rupee was paid for each maund weighed. Nearly all the undetained inhabitants of the city laboured, and the troops and the boys of the large High School assisted. The collection of the insects was very simple, as they could be shaken off the trees by thousands into sheets held below. Four men could collect a maund in a very short time. There

were ten weighing stations established, and the district funds were freely drawn upon. According to a crop report published in June 1891 numbers of young locusts in the Hangu Tahsil of Kohat were also destroyed by firing the dwarf palms through which they were crawling, while in the Barak ilaqua the destruction is noticed in the same report of some three thousand maunds of young locusts.

In Jhelum the destruction of eggs began early in March. From five hundred to six hundred maunds of eggs were destroyed in one tahsil. At first one anna, and later half-an-anna, a seer was paid for the eggs, while gur and atta were distributed to the people engaged in destroying the young locusts. Some R3,000 was noticed as spent from district funds in the early part of the spring upon the destruction of eggs and young locusts. But the Deputy Commissioner states that the people were inclined to be apathetic, as, from the dimensions of the plague, it seemed hopeless to cope with it.

In Shahpur the Naib-Tahsildar of Khushab was put in special charge and large numbers of young locusts were destroyed, though little real impression was made upon the pest.

In Gujranwala in March many of the winged locusts were killed in the mornings and evenings when they were inactive. Every patwari, lambardar and policeman was made responsible for reporting at the tahsil whenever eggs were laid or young appeared. Land in which eggs had been deposited, if not under crop, was ploughed three or four times so as to expose them. Eggs also were collected in great numbers, the usual plan being to make each house in a village furnish daily a "tind" or well-pot full of eggs.

In Sialkot bands of villagers were organised to kill the young locusts. The methods adopted were, driving them into trenches and burying them, and surrounding them with a circle of men armed with branches, who gradually drove them into straw, which was then burnt.

An interesting account is given by Colonel Lance, the officer commanding at Ferozepur, of the methods adopted in fighting the young locusts which invaded that cantonment in May 1891. Both British and Native troops were employed in the work, and Colonel Lance writes:

"Each corps and detachment was given certain limits within which it was to work and to do its best to destroy any swarms that came within them; corps, however, were employed at other places that were heavily threatened, as required.

"With the exception of one heavy swarm that came on the 17th Bengal Cavalry lines, the swarms came on the south-west corner of the station, and on the south-east and north-east as far as the cemetery, near the Sudder Bazar. In the Commissariat-Transport lines they were in countless numbers, and for days it seemed as if they would succeed in getting into the station from that direction.

"The method principally adopted to destroy the locusts was by burning them with dry grass. When swarming in trees or bushes this seems to be the only effective method. When in open ground it is easy to drive them to lines or clumps of dry grass in which they swarm, and which is lighted when the whole swarm has collected. The objection to this method, however, is the enormous expenditure of grass, even when used economically, as was done when the men became experienced in the work. Large quantities of grass were bought, but the Executive Engineer placed at my disposal a large quantity of old thatch, without which it would have been impossible to have provided the quantity of grass required. Kerosine was tried with the grass. It was used chiefly to burn the locusts out of trees and bushes, but it was found after trial that in most cases the grass was nearly as effective without kerosine, a great deal of which was required to produce any result.

"It was found that grass could be much economised by digging a small trench about a foot deep and a foot wide, filling the bottom with a little grass and laying the same lightly on the earth thrown upon the side opposite to that towards which the locusts were being driven. A little more grass sprinkled round the trench after the swarm had been driven into it, and set fire to, effectively secured the destruction of the swarm with but little expenditure of grass.

"Pits were also dug into which the locusts were driven and then buried. This plan is said to answer well when the insects are small, but when, as in the present case, they are large and active, it was found that they could not be kept in the pits unless they were dug very deep, and even then many succeeded in getting away.

"I had the opportunity of trying the method said to have been used with great success in Cyprus. Low canvas screens were made from condemned tents supplied from the arsenal, and strips of American cloth, over which the locusts cannot crawl were sewn to their upper edge. In front of these screens, which were set up in the path of the locusts, pits were dug, round which an edging of tin was placed, up which the locusts could not crawl. Driven against these screens the locusts either hopped into the pit themselves, or were driven in by men who eventually surrounded them. The advantages of this plan are the extent of ground that is covered, the comparatively few men that are required, and the completeness of the operation, as if the screens are sound and the drive conducted with skill and patience, scarcely any locusts can escape being driven into the pits. The tin rim obviates the necessity of the pits being dug deep, 2 or at most 3 feet being sufficient. The rims used were 4 feet by 2 feet, an edging of 2½ inches of tin on the ground surface round the pit, and the same width on the inside edge of it.

"I regret that I knew of this plan too late to provide sufficient screens for general use. I believe that this system will be found most efficacious, and feel confident that had we been prepared with this apparatus the work of destruction would have been carried on with less trouble, and with better results."

In Jhang, according to a crop report issued in June 1891, twenty thousand maunds of locusts had up to that time been destroyed.

The above comprises all detailed information which has reached the Museum on the subject of what was done in the Punjab in the spring of 1891, but numerous incidental notices have been received of the work of destruction which seems to have gone on systematically in all districts where young locusts hatched out.

With regard to what was done in Sind and Rajputana, where egg-

laying also went on, little fresh information has been obtained, but the people seem as usual to have done what they could in the way of destroying the young locusts by driving them into trenches.

In the case of the measures taken in districts that were only visited by flights, no fresh information has been received, but the system which has proved so successful of driving the insects off the crops, is believed to have been universally adopted by the cultivators.

E. C. COTES,

Deputy Superintendent,
Indian Museum, Calcutta.

8th June 1892.

NOTES ON INDIAN APHIDES.

By G. B. Buckton, F.R.S.

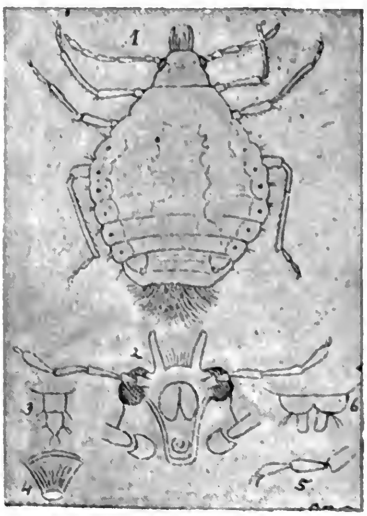
But little attention hitherto has been given to the tropical Aphides of the old world. Any addition to our knowledge of the species which inhabit British India doubtless will prove of interest, both as being connected with scientific entomology, and with agricultural economy.

Hitherto these Homoptera have been regarded as chiefly inhabiting the temperate regions of the world, but there are reasons for believing that observation only is needed to prove the existence of diverse species, which control the vegetation which flourishes under the equator.

The Aphis which attacks the bamboo (*Bambusa arundinacea*) of Dehra Dun, hardly accords with any described European species or even genus. Amongst many hundred specimens sent to me by Mr. Cotes I was unable to find a single winged individual, a circumstance which for the present prevents a complete diagnosis of the species, since the wing venation is of high importance for classical grouping. The characters of the bamboo Aphis, however, are sufficiently distinct to justify, in my opinion, the erection of a new genus, notwithstanding that the diagnosis at present can refer only to the apterous viviparous female.

Genus *Oregma* (from ὀρέγειν to protrude), Buckton. Body globose. Vertex conspicuous from the projection of two straight horn-like processes. Cornicles small and conical. Cauda inconspicuous, often tufted with numerous setæ. Rostrum exceedingly short and rising from between the first coxæ.

Oregma bambusæ, Buckton.—Body globose, less so in the immature forms. Corrugated and constricted into segments. Vertex with two cornua. Eyes very small. Notum narrow. Rostrum very difficult to see, rising from the underside of the thorax, much as in Coccus. Antennæ about half the length of the body, obscurely five-jointed and ending with a nail-like process as in Lachnus. Legs short. Tarsi with two articulations. Colour greenish brown, more or less mottled with black. Many of the specimens preserved in weak spirit were quite black.



Size 0·070 × 0·050 inch.

Clusters on the upper surfaces of

the bamboo at Dehra, covering the foliage of the plants with its sooty-black excretion, thereby doing some injury.

The winged female and the (apterous?) male are undescribed.

The general appearance of this insect may suggest some affinities both with the genus Lachnus and the genus Chaitophorus; but the small size of the insect, the short legs, the peculiar front, and the position of the very short rostrum will eliminate it from the first genus, whilst the non-tuberculose and slightly hirsute characters of the abdomen, etc., will separate it from the latter.

An examination of the winged insect will be interesting, and show the group to which this aphis should be referred.

Description of the figures—

Fig. 1. Apterous viviparous female.

" 2. Underside of the head, showing the position of the rostrum between the fore-coxæ, the two cornua, and antennæ.

" 3. The two jointed rostrum.

" 4. The cornicle.

" 5. Tarsus.

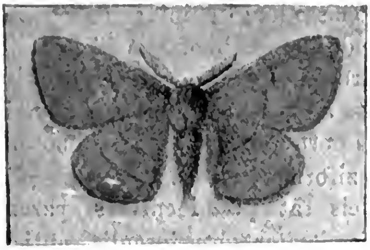
" 6. Abdominal apex of immature forms.

A NEW LASIOCAMPID DEFOLIATOR.

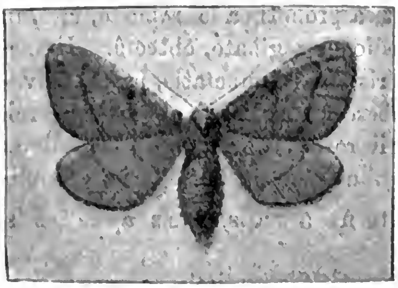
By F. Moore.

Spalyria minor. ([1]) n. sp.

Male.—Upperside very pale ochreous-yellow. *Fore-wing* crossed by a medial and a discal faintly indicated slender dusky band, both of which are parallel with the outer margin, the outer band being incurved at its anterior end, and the inner band bent inward and slightly waved. *Hind-wing* crossed by two similar slender bands, both parallel with the outer margin and incurved, inner band slightly waved.



Underside somewhat darker ochreous, both wings crossed by two less apparent slender bands, as on the upperside. Front of head, palpi, and legs above brighter ochreous; pectus brownish ochreous; body above pale ochreous; abdomen beneath a little darker; antennæ pale ochreous; the shaft paler; eyes black.



Female.—Wings longer and narrower than in male. Upperside uniformly purpurescent ochreous-brown. *Fore-wing* crossed by two similar dusky bands, which are somewhat broader and darker than in male, the inner band passing through a darker spot at end of the cell. *Hind-wing* with two similar bands, which are straighter in their course across the wing. Cilia edged with pale cinereous. Body darker purpurescent ochreous-brown; front of head, pectus, and legs brighter coloured. Underside somewhat paler; both wings with the transverse slender bands less apparent. Antennæ dark ochreous-brown.

Expanse—♂ $1\frac{3}{8}$, ♀ $1\frac{7}{8}$ inch.

Habitat—Burma

Feeds on herbage.

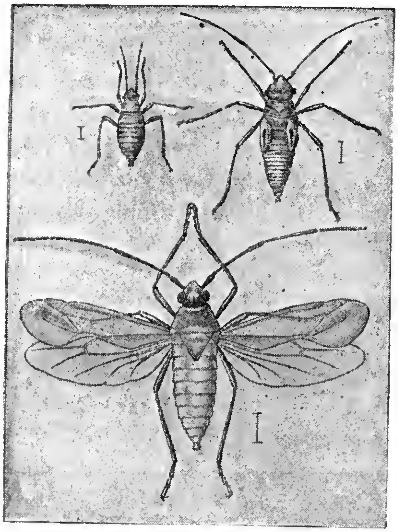
[1] The caterpillars of this insect are said to have proved injurious in Shwebo, Burma. For a note on the subject, see page 20 of No. 1 of this volume. The types here described consist of a single pair of specimens; of these the male is preserved in the Indian Museum, and the female is to be found in the Phayre Museum, Rangoon—Ed.

A NEW CAPSID PEST.

By Mons. L. Lethierry.

Calocoris angustatus (1) Leth. nov. sp.

Valde elongatus, sordide flavescens: antennis fulvis, articulo primo sat robusto, longitudini capitis æquali, secundo longissimo, gracili, primo quadruplo longiore, tertio, quarto et quinto æqualibus, gracillimis, longitudine primo æqualibus. Pronotum trapeziforme, punctulatum, angulis posticis sat prominentibus, parum acutis, leviter obtusiusculis, anticis obtusis, margine antico collari distinctissimo, calloso, tertiâ parte anticâ pronoti callo robusto, lato, in medio emarginato, obtectâ. Hemelytris flavis punctatis, parce fulvo-pubescentibus, clavo et parte suturali corii roseis, interdum concoloribus: pedibus concoloribus, tibiis spinulis nigris decem aut undecim in parte externâ armatis, tarsis apice fuscis. Long. 6—7 millim.



Formâ angustatâ congenericis Europœis distinctissimus.

Prov.—Madras.

(1) This insect is noticed on page 27 of No. I of this volume. It is said to injure cholum (*Sorghum vulgare*) in the South Arcot District of the Madras Presidency—Ed.

THE MANGO SHOOT PSYLLA.

By G. B. Buckton, F.R.S.

Psylla cistellata[1] n. sp.

Head small. Eyes globose and prominent. Vertex nearly straight, with a fine vertical sature. Tumid behind the eyes. Antennæ about $\frac{1}{6}$th the length of the insect, each springing from the face near to the inner margin of the eye. The 4th, 6th, and 7th joint cylindrical, and nearly equal in length. The apical joint terminated by two strong and long setæ. Combined pro-meso-and meta-notum large. Abdomen deeply corrugated and ringed. The dorsal part much raised. Apex of the female terminated by a sharp cauda, composed of genetal plates, saws and rasps, not unlike those seen in the Tettigidæ. The genitalia of the males complex. Legs stout and rather short. Tarsi with two distinct joints terminated by blunt claws and two fine hairs.

Membranes of the fore-wings furnished with a large, darkish, long, stigmatic cell, from and below which runs the strong cubital nervure which furcates at about two-thirds of its length. This furcation forms the subcubital nervure, and shows two forks, the outer of which runs to the margin, and the inner one nearly so, it being interrupted only by a curved inter-marginal vein. The lower wings are very delicate, and the neuration faint and difficult to trace.

Colour of the body shining pitchy-black, except the fore-edge of the pronotum which is rufous yellow. The underside also is black except the three last abdominal segments, the legs and the cauda, which are feruginous yellow. Membrane of the wings fuscous. Antennæ fuscous, except the two apical joints which with the tarsi are black.

This insect attacks the mango (*Mangifera indica*) and causes the terminal shoots of the tree to assume the form of imbricated pseudo-cones of a bright green or yellow colour. When cut open they show a central piliar, from which septa or curved walls proceed and form chambers which appear to have free communication one with the other. I could find no external openings to the two cones submitted to my inspection,

(1) A note on this species appeared on page 13 of No. 1 of this volume. The insect damages mango trees in Dehra Dun, North-Western Provinces, by aborting the young shoots. The specimens were furnished by the Director of the Forest School. Mr. Buckton writes that it may prove hereafter necessary to erect a new genus for the reception of this species; for the present, however, he includes it in the genus Psylla, to which it is most nearly related.

but I extracted several almost completely developed imagoes from the chambers and also the exuviæ from larvæ. Probably the above insects were hardly ready for exclusion, and hence the imperforated condition of the cones.

Some interest attaches to the circumstance that the Terebinthaciæ to which mango tree is referable are peculiarly open to the attacks of gall-making insects. We have numerous examples of Pemphiginæ amongst Aphides infesting the foliage of exotic species.

Size of insect	0·14 × 0·08 millemetres.
Wings	0·13.
Antennæ	0·04.

NOTE ON THE PESTS OF THE TEAK TREE.

By Major C. T. Bingham.

At page 46, No. 2, Volume XVIII of the "Indian Forester," there is a note by Mr. J. Nisbet, Deputy Conservator of Forests, on the damage done to the teak plantations in the Pegu Circle by the larva of a moth.

This moth, called by Mr. Nisbet, "*Tortrix* (*Tectonæ* ?)," does not, so far as I know, occur in Tenasserim. During the past three years, while on tour in the forests, I have made careful search, and been always on the look out, but have failed to find it. Quite recently also at my request Mr. P. W. Healy, Extra Assistant Conservator of Forests, went the round of the whole of the teak plantations, and over much of the natural forest in the Ataran valley, without coming across a single teak tree attacked by the pest.

As it was a matter of some importance to procure the moth and have it properly identified, on the 23rd April of this year I sent a servant, who has been used to collect insects for me, to Rangoon and by the kind permission of Mr. Jellicoe, Deputy Conservator of Forests, in charge of the Rangoon Forest Division, he was enabled to proceed to the teak plantations in the Magayi reserve, where the plague of caterpillars destructive to the leaves of the teak had set in. This plague, I believe, occurs annually in some portion or another of the Rangoon Division.

Some 50 or 60 larvæ were procured by my man, who returned on the 30th.

Unfortunately I had been obliged a day or two earlier to go out into the district, and I did not return till the 6th May.

On examining the box containing the caterpillars, which had, according to directions I had left, been looked to daily and fed with fresh teak leaves, I found that the majority had not only pupated, but that a good number of the moths even had issued. Luckily, however, there were still some 12 or 15 remaining in the larval state.

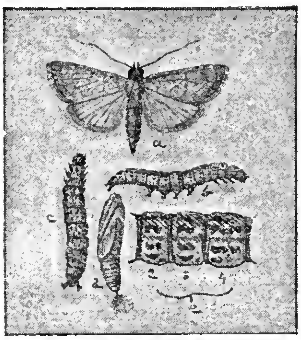
The moths I found were of two species.

One, a soft dark robust-bodied moth, with an expanse of 1·3 inches,

has been identified by Mr. Cotes as a Noctues moth of the family *Hyblæidæ*,

species *Hyblæa puera* Cramer. On the *upper side,* the ground colour of the fore-wing is ashy grey with a tinge of yellow, shaded at the base of the wing on the disc, along the costa, and broadly along the outer margin with soft dark brown; hind-wing dark brown with an irregular band on the disc not reaching the costa, and a large squarish mark at the anal angle vermilion red. Cilia of the fore-wing dark brown, of hind-wing brown with a light wash of pink. *Underside,* both wings pale vermilion red turning at the base, along the costa and on the disc of the fore-wing to yellow; an irregular mark on the fore-wing and two spots at the anal angle of the hind-wing, with some indistinct shadings dark brown.

The larva measures a little over one inch in length. It is whitish yellow beneath, dusky greenish above. Along the middle of the back is a pale flesh-coloured stripe with darker smoky brown stripes one on each side, which latter are each outwardly margined by an indistinct and somewhat interrupted white line. Head dark brown; a few erect dark hairs scattered over each segment.



The second species, Mr. Cotes informs me, is new to the Indian Museum collection, but that it is undoubtedly one of the Pyrales and very close to *Paliga (Scopula) damastesalis* Walker.(1)

The following is a brief description of the larva and moth.

Larva: length 0.7 to one inch. Colour pale sap-green; two lines of purplish spots along the middle of the back. Head yellow; a few pale erect hairs scattered over each segment.

Moth: expanse 0 9 inches. *Upperside* pearly white with a slight creamy tinge; fore-wing marked along the costal and outer margins and across the disc with spots of red, forming on the last indistinct narrow red cross bands; hind-wing with the outer margin narrowly edged with the same colour. Cilia of the fore-wing alternately red and white; of the hind-wing pure white. Underside pearly white.

The larvæ that had not pupated had all turned by the fifth day after my return. Both species seem to take the same length of time over their metamorphosis, the moths issuing from the 8th to the 11th day after pupation.

The *Hyblæa* formed a rather flimsy cocoon either in the corner of the box, or along the mid rib of a leaf, dragging the sides of the leaf slightly together with the web. The *Pyralis* invariably rolled itself up in the edge of the leaf, holding it in position by a few threads.

(1) The specimens have since been submitted to Colonel C. Swinhoe, who was kindly examined them and determines the species as *Paliga damastesalis* Walker—Ed.

My recollection (for I unfortunately have mislaid the notes I took) of the ravages of these caterpillars when I was in charge of the Rangoon Division, is that they appeared in the teak plantations on or about the 20th May, sometimes in almost incredible numbers. Their ravages were confined to certain areas, where they re-appeared year after year stripping the young teak of their leaves with the rapidity almost of locusts, and hanging in thousands by webs to the branches of the trees.

It is quite possible that *Hyblæa puera* may, like the *Tortrix murinana* mentioned by Mr. Nisbet in paper above quoted, pupate among the dead leaves on the ground, but, if so, I should fancy few individuals could survive, for a plantation attacked by these pests is a wonderful scene of activity. Numbers of jungle fowl, ground thrushes (*Pitta*), and insectivorous birds of all kinds crowd to the spot to feed on the caterpillars.

The *Pyralis*, as I have already said, rolls up the edge of a leaf and is thus rendered less conspicuous and saved from enemies. It certainly occurs in far greater numbers than the *Hyblæa puera.*

MAULMAIN;
18th June 1892.

MISCELLANEOUS NOTES.

Galls on spruce fir.

In April 1892 some galls found upon spruce fir (*Abies Smithiana*) trees near Chakrata in the North-Western Himalayas, were sent to the Museum by the Director of the Dehra Dun Forest School. The galls were superficially very much like small fir cones. They were inhabited by aphids, which are believed to cause the abnormal growth by irritating the tissues of the shoot in feeding. The insect appears to be closely allied to the species *Chermes coccineus*, Ratz., which attacks fir trees in Europe in a similar manner. The Museum does not possess specimens of the European form, so some of the Chakrata galls have been sent to Europe for comparison.

Notes from Ceylon.

In an interesting communication received in May 1892, Mr. E. E. Green writes that an ant which has been indentified as *Dorylus longicornis* sometimes attack potatoes (*Solanum tuberosum*) to such an extent in Ceylon as to make it impossible to grow this vegetable. Mr. Green found that the some ant also attacks the roots of other garden plants, working so insidiously that the damage usually remains undiscovered until it is too late to save the plant. Mr. Green suggests that the ant noticed on page 42 of Volume II of these *Notes*, attacking potatoes in Burma, may perhaps have belonged to the same species. Mr. Green also forwards some scale insects (*Coccidæ*) found on Tasmanian apples which were being sold in Ceylon. The scale contained living eggs, which would, no doubt, in due course have hatched out producing active larvæ capable of establishing themselves in any place where they happened to light upon a suitable plant. As Mr. Green points out, the find is an interesting one as showing how easily insects of this kind may be introduced from enormous distances. The scale insect in question is likely to have been *Mytilaspis pomorum* Bouché, which often does much damage in orchards. As, however, the specimens of this species in the Museum collection are very poor ones, there is some little doubt about the identification.([1])

Mustard aphid.

With regard to the identification of the Aphid noticed on page 46 of Volume II of these *Notes* as very injurious to the mustard (*Brassica*) crop in Hooghly, Mr. G. B. Buckton, F.R.S., who has kindly examined the insect, writes

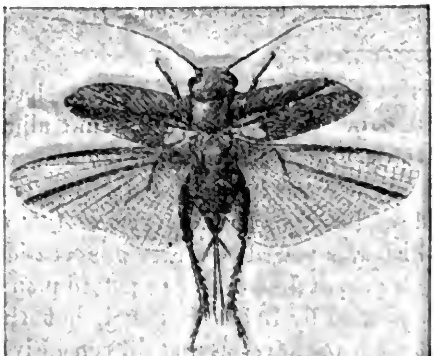
[1] The insect has since been kindly examined by Mr. W. M. Maskell, who confirms the identification, and notices that the species is one which attacks several trees in the temperate zones; it is specially common upon apple trees and hawthorn in New Zealand.

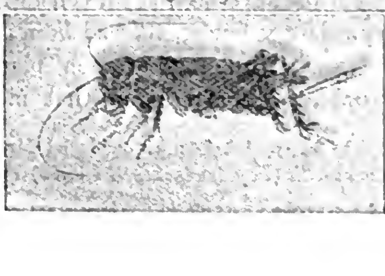
that, so far as could be made out from the specimens forwarded, the insect seems to be identical with the species *Aphis brassicæ* which attacks *Sinapis arvensis* and other field crops in England. It would be desirable to procure further specimens to enable the insect to be identified with certainty. It is likely to be the one noticed by Duthie and Fuller, in their *Field and Garden Crops*, as attacking *Brassica compestris* (rape) and its varieties in the North-West Provinces. The following is an extract from their valuable work (Part II, page 31) :—

" The outturn of rape is extremely precarious, or otherwise it would be much more generally grown as a sole crop than it is, since area for area the value of a crop of *sarson* would be considerably greater than that of a crop of wheat. It is, however, peculiarly liable to the attacks of a species of blight, and in damp seasons every plant in a field is not uncommonly covered with tiny insects (Aphides), which suck the sap from the flowering shoots and effectually prevent any seed from growing. Where holdings are large, as they are in the sub-Himalayan country, a cultivator can afford to risk the total loss of the crop on a part of his land, with the chance before him of handsome profits if the season is propitious. But in the crowded districts of the Doáb the total loss of a crop means such distress to the cultivator that he prefers to make a certainty of a moderate profit rather than run any risk in aiming at a large one. The cultivation of rape as a sole crop in some parts of the provinces, and as a subordinate crop in other parts, is therefore explained by a difference in the density of population."

Cricket injuring potato plants.

In March 1892 Mr. J. Mollison, Superintendent of Farms, Bombay Presidency, forwarded specimens of a cricket which had proved destructive to potato plants in Khandesh, by cutting through the stems near the surface of the ground. The insect was found to be indentical with specimens in the Museum collection which have been determined by Dr. Henri de Saussure as *Liogryllus bimaculatus* DeGeer (Gryllidæ), a species which has not previously been noticed as destructive in India. Crickets of this kind are very difficult to deal with; flooding the land to bring them to the surface, where the birds can get at them, may be useful in cases where it is practicable, while dressing the land with gas lime soot and such fertilisers as *kainit* might perhaps be worth trying, though there is little evidence to show that they do much good.



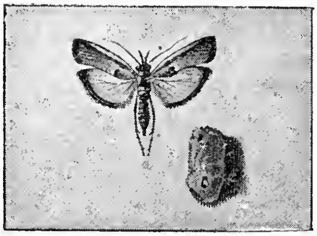


Castor-oil seed caterpillar.

In April 1892 Mr. A. V. Knyvett forwarded specimens of a moth, the caterpillar of which had been noticed as attacking castor-oil plants (*Ricinus communis*) in the Sonthal Pergunnahs. The specimens were in too poor a state of preservation for satisfactory examination, but, as far as could be made out, they were identical with specimens in the Museum collection which have been determined as belonging to the species *Conogethes punctiferalis* Guén. The caterpillar attacks the seeds and is said to have done a large amount of damage.

Crotalaria Juncea caterpillar.

In March 1892 Mr. J. Mollison, Superintendent of Farms, Bombay, forwarded pods of Bombay hemp (*Crotalaria juncea*) tunnelled by the larvæ of a micro-lepidopterous insect. Mr. Mollison wrote that the insect had been very destructive in Baroda in the months of October and November, a third



of the pods kept for seed being affected. When full-fed the caterpillars spun themselves up into little silken cocoons, which, in the case of the ones reared in the Museum, were attached to the sides of the box in which the pods were placed. It is probable, therefore, that the habit of the insect is to desert the pods before spinning its cocoon. Moths emerged in the early part of April; they prove to be Phycidæ, but the species is new to the Museum collection, so specimens have been sent to Europe for precise identification.(1)

Potato pests in Sikkim.

In April 1892 some cut worms and Elateridæ larvæ, said to have proved destructive to potato plants in Kalimpong, Darjeeling, were received from Babu N. G. Mukharji. The insects were too immature for precise identification, but the cut worms were likely to have belonged to the species *Agrotis suffusa* Fabr. (Noctues) a species which was reared on a previous occasion in the Museum from caterpillars which proved destructive to potato plants in Kurseong. Kerosene emulsion was tried by Babu Mukharji, but the results, though encouraging, do not seem to have been at all conclusive. At the time that the emulsion was applied very few stems had been cut, though numerous grubs were to be found at the foot of each plant; after the emulsion had been applied, Babu Mukharji found that more

(1) The insect has since been kindly examined by the well known entomologist Mr. F. Moore, who identifies it as the species *Mellia zinckenella* (*Phycis zinckenella* Triet.) a not uncommon Phycid in Europe, India, and Ceylon.

than three-fourths of the plants died, but the grubs disappeared and the plants that remained seemed vigorous; so it is possible that the plants which died were merely those which had previously been injured by the grubs. It should be noticed, however, that Kerosene emulsion is not usually recommended for use against cut worms or Elateridæ larvæ in other parts of the world. In India hand-picking seems to be the only method that has hitherto been adopted for fighting these classes of insects, which live chiefly underground. In England ploughing gas lime into the land when the crop is off the ground has been recommended against similar insects, while such dressings as soot, guano, nitrate of soda, salt, and rape dust are all said to be useful.

White insect wax.

In January 1892 a few specimens of the white wax insect *Ceroplastes ceriferus* Anderson, were forwarded to the Museum by Mr. J. Deveria, who wrote that it was plentiful on trees in Purulia. This is of interest in case more specimens of the insect are wanted in connection with the inquiry dealt with in Volume II, No. 3, of these *Notes.*

The rice sapper in Ceylon.

In March 1892 specimens of the rice sapper (*Leptocorisa acuta* Thunb.) were forwarded to the Museum by Major Yerbury from Trincomali in Ceylon, where the insect was said to have proved destructive to the rice crop.

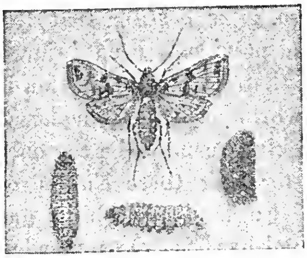
A supposed enemy to the tea plant.

In April 1892 an insect was received through the kindness of Messrs. Barry & Co., with the information that it was thought to have been the cause of some damage to tea bushes in Cachar. The insect proves to be one of the Curculionidæ beetles. It is identical with a specimen in the Museum collection which has been determined as *Astycus chrysochlorus* Wied. It had been forwarded by Mr. John Leckie of Cachar, who was of opinion that it was responsible for the stripping of the young leaves off the tea shoots, noticed in several parts of the garden. The insect is not unlikely to feed on the young tea shoots, but it has not previously been reported in this connection, and is not expected to occasion much injury.

Brinjal borer.

The Brinjal (*Solanum Melongena*) fruit, which is brought to the Calcutta market, is sometimes found to be attacked by the caterpillar of a microlepidopterous insect which bores into it much in the way that the caterpillar of the coddling moth bores into apples. Caterpillars of the brinjal borer obtained on the 26th April 1892 began to emerge, in the Museum, as

moths on the 5th of May. In the case of one at least of the specimens, the caterpillar, when full fed, seems to have deserted the fruit and spun itself up into a very slight silken cocoon upon the side of the cage, and this is likely to be the general habit of the insect, though it would be as well to observe further specimens before concluding that the habit is an invariable one. The moth proves to be indentical with some specimens in the Museum collection, which have been determined by Colonel Swinhoe as *Leucinodes orbonalis* Guén. (Pyrales). This species has been recorded as occurring in all parts of Northern India; also in Burma, Ceylon, the Andaman Islands, Java, and South Africa.



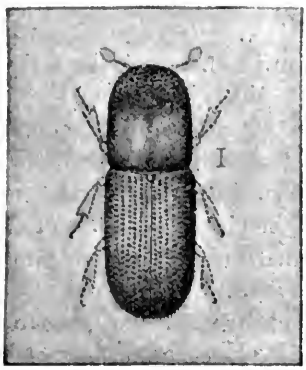
Orthoptera in Shahpur.

In July 1891 some Orthopterous insects were forwarded to the Museum by the Deputy Commissioner of the Shahpur District, Punjab. They were of two kinds known respectively as *Toka* and *Tiridda.* Both species were said to be exceptionally numerous in Shahpur, where they had done considerable damage to the young summer crops. The *Toka* insect proved to be a cricket allied to the genus *Gryllodes,* but hitherto unnamed in the Museum collection. It has, therefore, been sent to Europe for identification. According to the reports furnished by the district officers, this insect sometimes does much damage to young bajra (*Pennisetum typhoideum*), jowar (*Sorghum vulgare*), cotton (*Gossypium herbaceum*) and other crops, both in Shahpur and also in Hissar where it is known by the same name. It appears in the latter part of April. During the day time it generally lies hidden in the ground, but in the cool of the evening it comes out and feeds upon the young plants, but does little damage after the crop is four or five inches in height. It disappears in the latter part of the rainy season. With regard to the life history of crickets of this kind little has yet been observed in India, but in the case of allied species in the United States, according to Comstock (*Introduction to Entomology*) the eggs are usually laid in the ground in autumn. They hatch in the following spring, and the insects mostly die off on the approach of winter. With regard to remedies, too little is yet known to enable any very definite treatment to be recommended, but breaking up the ground in the cold weather would seem likely to be useful, as it would expose the eggs, both to their natural enemies the birds, and also to the extremes of temperature, which would probably be unfavourable to hatching. The *Tiridda* insect proves to be an Acridid grasshopper of the genus *Chrotogonus,* which has been referred to on several occasions in these

Notes as a common pest to young indigo (*Indigofera tinctoria*) and other crops in various parts of India. Little is known of its habits, and no satisfactory means of dealing with it seems yet to have been recorded.

Xyleborus perforans.

In the *Kew Bulletin* for April 1892 is an interesting note on the subject of the little Scolytid beetle *Xyleborus perforans* Wollaston which has recently been reported as attacking growing sugar-canes in the West Indies. The species was originally described by Wollaston from specimens found perforating the bungs of wine casks at Madeira. In South America it has been recorded as boring into rum casks, also as frequenting cane refuse and rotting vegetable matter, and as attracted by lights at night. In India it has been noticed as boring into beer casks.(1) The danger now is that it may take to attacking growing sugar-cane in India to a serious extent as it is said to have already done in the West Indies. With regard to remedies the Editors of the *Kew Bulletin* write :—



"There should be no difficulty experienced by intelligent planters in the West Indies in dealing with this cane-borer. The infested canes should be destroyed, either by burning or passing through the rollers of the cane mills. Care should be devoted to the selection of 'plant' canes, to ensure that they are free from the grubs and eggs of the beetle, and precautions should be taken to get rid of all the cane refuse in a decayed state in the neighbourhood of the cultivated fields. In other respects the same steps are necessary with this borer as have been found effective in the case of the moth borer. This latter has been known to attack sugar-canes at intervals for nearly sixty years,(2) but its influence has been rendered comparatively harmless by the systematic destruction of infested canes, and by examining and dressing the 'plant' canes before they are put into the fields. These simple and effective methods are fortunately within the reach of every one."

---

(1)It was at first supposed to belong to the genus *Tomicus*, and the commissariat serjeants are said to have appropriately dubbed it "Tippling Tommy." In his report on Insects destructive to forests, Allahabad 1868, Mr. R. Thompson writes: "I believe this to be a species of *Tomicus*, a minute cylindrical species I have observed boring into beer and water casks ; as they bore clean through the wood, the liquor may be seen jetting out at various points, and by the force of the discharge the little borers are thrown out with it."

(2) *Vide* the account of this insect given in Volume I, page 22, of these *Notes*.

The figure is drawn from a specimen from the West Indies presented to the Museum by Mr. W. F. H. Blandford. The length of the specimen is about two and a half millimetres. Its colour is light-chestnut brown. The legs and antennæ in the figure are merely dotted in to give an idea of their probable shape, for the setting of the specimen does not permit of an accurate drawing being made of these appendages, and it has been thought best not to run the risk of damaging the specimen by disarranging it for the purpose as it is at present unique in the Museum collection. The markings shown in the figure on the prothorax and elytra will probably be sufficient to enable the insect to be recognized when met with in sugar-cane, but it should be noticed that there are a large number of very similar, though distinct insects, to be found boring into the bark of trees in India.

Fungoid disease *versus* Melolonthini larvæ.

An interesting summary of what is known on the subject of the Fungoid disease (*Isaria densa* Link. = *Botrytis tenella* Saccardo) which attacks Melolonthini larvæ is given in the April number of the periodical *Insect Life.* The large amount of damage which is done by Melolonthini larvæ or "white grub" in India makes the question of the practicability of utilising this disease for destroying the pest, an important one, but the evidence at present available on the subject is very contradictory. According to M. Alfred Giard's paper in the *Comptes Rendus* of the 3rd August 1891, the spores retain their germinating powers for more than a year and the disease can be readily communicated not only to Melolonthini larvæ but also to other insects which live in a similar manner in damp situations. According, however, to M. Jean Dufour's paper in the *Chroniqua Agricole Viticole et Forestier du Canton du Vaux,* November 10th 1891, though the disease can be disseminated to a certain extent by infecting the soil either with artificial cultures or with fragments of diseased insects, the number of fresh grubs which take the disease is very limited.

E. C. COTES,
Deputy Superintendent,
Indian Museum.

CALCUTTA,
25th June 1892.

Govt. of India Central Printing Office.—No. 441 R. & A. (113).—6-4-93.—1,000.—R. B.

Vol. III.] [No. 3.

A NEW COCCID FROM CEYLON.

BY G. B. BUCKTON, F.R.S.

Orthezia nacrea.(1)

In March 1893 I received from Ceylon a consignment of twigs and leaves of *Crossandra* which were incrusted by a white semi-flocculent matter, which proved to be the exudation of a species of *Orthezia*, apparently undescribed. Of this Coccus I give the following description. Unfortunately the specimens arrived in a bad condition from the effects of mildew, which rendered the examination less complete than could be wished.

Female.—Not scaly-form. Wingless, but capable of slow locomotion. General shape long-oval or cylindrical. Head and thoracic portion pale warm brown. Rest of the insect, except the legs and rostrum, shining satiny white, with a porcelain-like surface. In some lights this gives nacreous tints. Head small, antennæ short and black, rather stout and about the length of the pronotum. The two basal joints the thickest, followed by six subequal tapering joints. Some of these are attenuated in the middle, thus simulating extra joints. The apex somewhat mammiform and without bristles. Eyes small, black, and placed just behind the antennæ. Legs black and rather long, tarsus single-jointed, but

(1) This insect, which was forwarded to the Indian Museum through Mr. E. E Green in January 1893, has proved very troublesome in the Botanical Gardens at Peradenuja. Ceylon, where it has been multiplying with great rapidity. From notes furnished by Dr. Trimen, F.L.S., it appears that it especially attacks *Acanthaceæ*, which include some of the most showy plants in the garden.

showing some tendency to a sub-division. Claw single. Rostrum short, stout, black, furnished with a long seta (? more than one), and placed between the coxæ. Pronotum fuscous, separate from the abdomen and furnished with two rows of dark spots. The lower border of the pronotum ends by several foleated cereus laminæ, pointed at their ends, and one overlapping the other somewhat like the scapular feathers of a bird's wing.

The white plates only partially cover the abdomen which becomes a marsupium or cradle to protect the twenty or thirty black eggs which hatch within the dead body of the parent, and find therein a secure covering until they are sufficiently grown to migrate over the food plant. The lower part of the abdomen is smooth and cylindrical, but the upper part is deeply furrowed or channeled into bundles of striæ. The sternum is slightly spotted.

Size female with the marsupium $0{\cdot}16 \times 0{\cdot}05$ of an inch.

An examination of the male is desirable. Doubtless it is winged. Attention should be called to the anal filaments, which in Orthezia, unlike other known Coccidæ, have numbered two instead of four. Mr. Douglas has so figured the male of *Orthezia insignis* (see Ent. Mon. Mag., Vol. XXIV, p. 169). This insect, which has close relations to the Ceylon insect, was first found on Strobalanthus, a Chinese plant growing in the economic houses at Kew Gardens.

I think the insect above described is distinct. The Kew insect is much larger (♀), its body is piceous black, and the thoracic laminæ are developed in a single instead of a double row. Observers on the spot have peculiar facilities for studying the economy and life histories of such insects. As the dipterous male insects of Cocci are very active, and they usually live only a few days in the early season of the year, attention and address will be required to secure them.

The Kew insect appears to be spreading over the hot houses of England and seems to be very difficult to annihilate. It does as much mischief as the more common "mealy bug."

Explanation of figures.

Fig. 1.—Female, with the black eggs appearing through the cover of the marsupium.

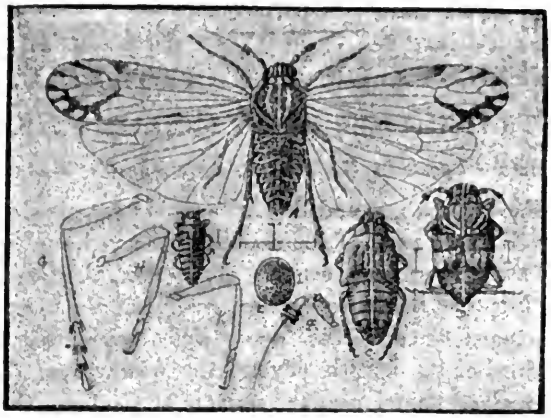
Fig. 2.—Hind legs with tarsus and claw.

Fig. 3.—Antenna.

A NEW SPECIES OF FULGORIDÆ.

BY MONS. LETHIERRY.

Delphax psylloides(1).



Caput thorace paulo longius, ante oculos paulo prominens, supra stramineum, subtus opacum, fuscum: vertice oculo uno æquali, basi excavato, carinis apicalibus acutis, prominentibus: fronte subelongatâ, carinâ distinctâ percurrente, basi furcatâ: clypeo medio distincte carinato: antennarum articulo primo flavo, apice nigro, secundo flavo, basi nigro, ultimis nigris. Pronotum et scutellum tricarinata, pallida, marginibus fuscis aut obscure stramineis, vittisque duabus disci longitudinalibus stramineis. Tegmina abdomine duplo longiora, hyalina, margine imo commissurali clavi, maculâ parvâ quadratâ marginali pone medium, necnon margine apicali superno (hoc hyalino-trifenestrato) nigris: venis apice nigris, discoidali mediâ apice furcatâ. Abdomen nigrum, lateribus segmentorum dorsalium pallido-maculatis. Femoribus nigris aut fuscis, tibiis et tarsis albo-pallidis.

Long. (cum tegminibus) 5 millim. ♂ ♀.

Formâ verticis D. Fairmairei Perris, affinis: picturâ tegminum insignis.

Ceylon.

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(1) The species was forwarded from Ceylon by Mr. E. E. Green, and the following particulars are taken from the interesting notes he has furnished regarding it. The insect is to be found in its various stages of growth swarming within the clasping sheaths of the leaves of the Indian corn plant (*Zea mays*). In wet weather it is accompanied by a sooty fungus which has not been noticed at other times. It is also attended by ants. The eggs are buried in the tissues of the plant on the inside of the sheathing leaves, the orifice being concealed by a deposit of white woolly secretion. The effect upon the plants depends upon the period at which they are attacked. If attacked when young, they are stunted and weakened. Older, well-established plants do not suffer so much.

Nympha: flava, tribus segmentis ultimis dorsalibus ad latera nigro-maculatis.

[The following is an explanation of the figure, which has been prepared by the Museum artist. A, imago; B, C, and D, larvæ in various stages of development; E, egg; F, antenna of imago; G, H, and K, hind leg, second leg and front leg of imago. The natural sizes of the various stages are indicated by hair lines.—*Ed.*]

A NEW ENEMY OF THE CUSTARD-APPLE.(1)

TRANSLATED BY F. MOORE, F.L.S.

Family Phycitidæ Genus nov. Anonæpestis, Ragonot.

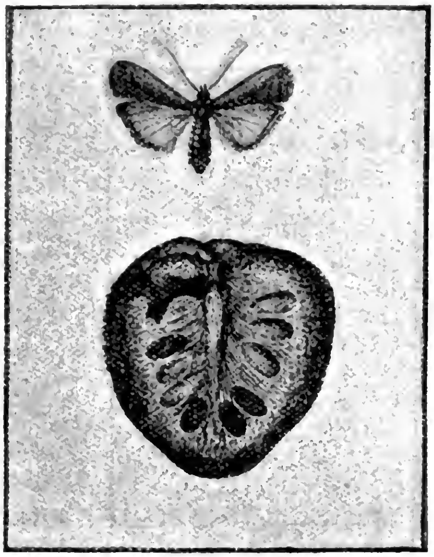
Female.—Face smooth, rounded. Antennæ of female slightly flattened. Tongue well developed. Palpi ascending, curved, somewhat oblique, thin, smooth, rather short, not reaching the vertex, the third joint nearly as long and as broad as the second, obliquely cut at the apex. Maxillary palpi scaly, flattened against the face. Body moderate, the abdomen reaching one-third of its length beyond the hindwings. Legs strong, flattened. *Forewings* subtriangular, narrow at the base, the costa very slightly arched, the hind margin and angles much rounded, slightly oblique; with eleven veins; cell reaching three-fifths of the length of wing, slightly concave at extremity; vein, 2 near the angle; vein 3 from the angle, curved, parallel with 3 and 4, veins 4 and 5 appearing stemmed, but in reality separate, originating from the angle of the cell and in a line with the median vein; vein 6 from below the upper angle, veins 8 and 9 stemmed; veins 10 and 11 from the cell. *Hindwings* nearly triangular, slightly sinuous below the apex; with seven veins; cell short, one-fourth of the wing; veins 7 and 8 long coalescing a short distance, vein 7 afterwards joined to 6; vein 5 free running very close to 3 and appearing stemmed with it; vein 2 very close to the angle; vein 4 wanting.

This genus, described on a unique female specimen, appears distinct from all others on account of the peculiar disposition of veins 2, 3, and 4 of the hindwings. It seems to partake of the characters of Psorosa and Heterographis. No doubt the male has peculiar palpi and antennæ.

(1) The specimen upon which the genus and species are founded was reared in the Museum from caterpillars found tunnelling into the fruit of the custard-apple (*Anona squamosa*) in Calcutta. The insect proved to be new to the Indian Museum collection, so was forwarded to Lord Walsingham, who submitted it to Mr. F. Moore. Mr. Moore writes:—"The moth from the custard-apple is also a Phycid, the specimen sent home being that of a *female*. This has been kindly examined and described for me by my friend Mons. Ragonot, who has characterised it as belonging to a new genus and species of Phycitidæ, to which he has given the names of *Anonæpestis bengalella*, and of which I herein send you an English description for publication in your Museum Notes." As the female only has yet been described, it would be desirable to procure the male.—*Ed.*

ANONÆPESTIS BENGALELLA, Ragonot, n. sp.

Female.—Length 22 mill. Forewings dark green, darker in basal area, the costa, in middle area, broadly pale yellow, with a greenish tinge, the dorsal half broadly purple, turning to dark violet on the inner margin of the median area; marginal dots black, large and distinct, placed between a series of pale longitudinal streaks in the terminal area, on the veins. Cilia fuscous, shining, pale brownish at the base, the extreme base of the wing also pale brownish. Lines distinct, pale greenish yellow edged, in median area, with the ground colours but darker, the first line oblique on costa, nearly vertical afterwards, but indented outwardly by two short angles on the discal and dorsal folds; second line very strongly dentate in the middle, indented on the discal and dorsal folds; beneath yellowish-green on the costa, the dorsal half fuscous. Hindwings brownish-grey with a purple tint; the costa tinted with greenish and shining; cilia whitish, a blackish line near the base; beneath paler. Head and thorax brownish-ochreous; the collar tinged with greenish; the thorax darker, tinged with purple. Palpi dark green, the end half of the terminal joint pale ochreous. Abdomen ochreous. Legs greyish-ochreous with greenish tinge; the tarsi brownish black.

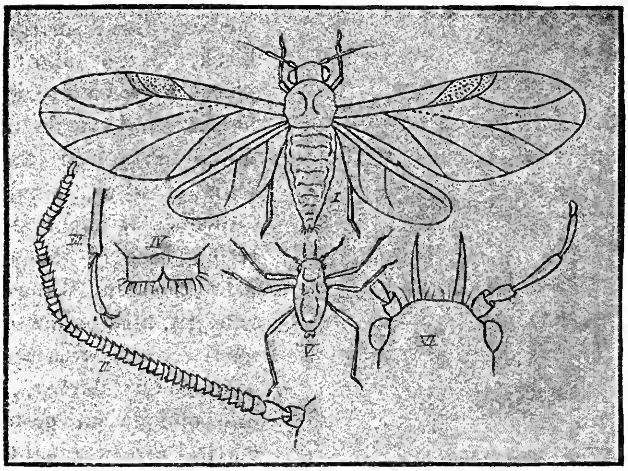


[In the figure, which has been prepared by the Museum artist, is shown the moth, natural size, also a section of a custard-apple tunnelled by the caterpillar, half natural size.—*Ed.*]

NOTES ON INDIAN APHIDÆ.

BY G. B. BUCKTON, F.R.S.

Oregma bambusæ,[1] *Buckton.*



Winged female.—Body wholly black. Head moderate, without marked cornua. Eyes obvions, antennæ, about one-third the length of the body. Five-jointed, the apex minute. The third joint much the longest and more than double the length of the fourth, both these and the fifth joints numerously ringed, as in Schizoneura. Rostrum short. Wings ample, membrane rather fuscous. Cubitus with a marked punctured stigma. Cubical vein once forked and not confluent with the cubitus. Lower wings normal. Candal end bilobed.

The small and younger larval forms have the two cornua below the vertex much produced, as shown in figure VI.

This aphis appears to infest the bamboo throughout British India, the somewhat smaller specimens taken in the North-Western Provinces

[1] This species of Schizoneurinæ was originally described on page 87 of this volume from specimens of the apterous form taken in Dehra Dun, North-West Provinces. The winged female, which is now described for the first time, was taken by Mr. E. E. Green, upon "the cultivated yellow-stemmed bamboo" in Ceylon. Mr. Green notices that although the apterous form is sometimes so abundant as to completely cover the surface of the bamboo shoots, the plant does not appear to be injured to any very great extent. He adds that in life the wingless form is of a dull state grey colour slightly obscured by a whitish bloom, the gravid females having a cushion of white meal upon the extremity of the abdomen. The winged form, on the other hand, is so dark in colour as to be almost black, and is without any whitish bloom.

do not differ, except in size, from those taken in Ceylon. This difference doubtless is due to moulting and age.

Attention of observers should be turned to conditions of hibernation, and towards deciding the question whether, like some other Schizoneurinae, they descend into the ground.

Expanse of alate form 0·29 millemetres.

Size of apterous form 0·10 millemetres.

The apterous form is figured in Vol. III, p. 87, of these *Notes*.

Fig. I, alate female insect. Fig. II, antenna of the same. Fig. III, tarsus and part of tibia. Fig. IV, caudal end. Fig. V, young specimen of larva. Fig. VI, magnified view of the head with cornua, etc.

MISCELLANEOUS NOTES FROM THE ENTOMOLOGICAL SECTION.

BY E. C. COTES, DEPUTY SUPERINTENDENT, INDIAN MUSEUM.

Girdler longicorn.

An interesting longicorn was forwarded through the Madras Museum in November 1892, by the Collector of Kurnool, with the information that it had been noticed cutting rings of considerable depth and about an inch in diameter completely around the branches of a *Tabernaemontana alba* tree. The specimen has been identified through the kindness of Mr. C. Gahan, of the British Museum, as a female of the species *Sthenias grisator,* Fabr. Mr. Gahan notices that the male may be distinguished from the female by a small process projecting obliquely upwards from the base of each of the mandibles in front of the clypeus. He adds that the British Museum possesses a specimen taken more than thirty years ago near Coimbatore which bears a ticket with the following note—"gnaws the bark of shrubs and is very destructive."

The same species was subsequently forwarded to the Indian Museum in January 1893 through the Imperial Forest School. In this case it was obtained by the Deputy Conservator of Forests, Coorg, who wrote:—"These beetles cut off the stem clean in one night......Large rose trees are thus cut down and destroyed. It is incredible that a small insect like the one I send can do such damage, and I would not have believed it had I not seen their ravages myself.......I got them this morning from off the rose bushes they had destroyed. They attack the main stem and despise smaller branches."

The rose stems forwarded with the insects ranged from three quarters to half an inch in diameter, and were cut completely off with remarkable neatness. The parent insect no doubt girdles the shoot with a view to afterwards laying its eggs above the notch. The habit is one that has been noticed with other species of the same family, and exemplifies the fact that withering trees are the ones most frequented by longicorn borers, the supposition being that a vigorous flow of sap is liable to choke the larva in its burrow.

A new Psychid.

A good deal of damage was reported in the early part of the rains of 1893 as done to tea in the Darjiling district by a species of case-making caterpillar. The insect was forwarded to the Museum on the 27th June through the

Agri-Horticultural Society of India. It proves to be a species of Psychidæ. The larvæ cases are somewhat looser in structure, but very similar both in size and shape to those of the species *Eumeta sikkima*, Moore, which is figured and described on page 63 of volume II of these *Notes*. When received the caterpillars were alive, but no leaves could be procured to feed them with in Calcutta. An attempt was made to rear them upon the leaves of a number of other plants, but they fed very sparingly and did not thrive. Several imagos however, both male and female, were successfully reared. As usual, in the Psychidæ the female is a degraded wingless creature, very much like the female of *Eumeta sikkima*. The male is an active dark-coloured insect, very considerably smaller in size than the male of *E. sikkima*. It is also more uniformly covered with scales. The species is new to the Indian Museum collection, so specimens have been forwarded to London for comparison with the types in the British Museum.(1)

Several specimens of a small Ichneumonid parasite, also a single Tachinid fly, emerged in the rearing cage, but have not yet been identified.

Teak-defoliators.

Both in 1891 and 1892 damage was reported in the forests of the Hyderabad Assigned Districts by caterpillars which defoliated the teak trees.

The specimens, which were forwarded to the Museum through the Forest Department in 1891, could not be identified at the time, as they were immature. They were preserved, however, for further investigation, and careful comparison with authenticated caterpillars since received from Burma shows that the insects in the two cases are identical. The species is the one referred to on page 94 of volume III of these *Notes* under the name of *Paliga damastesalis*, Walker. According to a report furnished by the District Forest Officer of Berar, the insect appeared in the early part of September, but information has not been received upon the subject of the extent of the damage that was occasioned.

In 1892 the insect was a different one. It proves, from the specimens forwarded to the Museum, to belong to the species *Hyblæa puera*, Cramer. Injury commenced earlier, and a good deal of damage was done in the beginning of the rainy season. The attack is said to have been very severe in pure patches of teak, but was less noticed in areas where the forest was a mixed one. The trees that were attacked looked quite

(1) The insect has since been identified through the kindness of Mr. G. F. Hampson as *Amatissa consorta*, Templ.

brown amongst the surrounding foliage, and ultimately lost their leaves, but a new flush of leaves soon appeared. When full fed the caterpillars were said to have let themselves down by silken strands and to have formed cocoons in the ground.

The species *Hyblœa puera*, Cramer, has previously been recorded as attacking teak in Lower Burma, as well as in Dehra Dun, North-Western Provinces, and in the Kulsi plantation in Assam, so probably occurs throughout India.

Achaea melicerte.

Injury by the caterpillar of the Noctues moth *Achæa melicerte*, Drury, was reported in August 1892 from Dehra Dun in the North-West Himalayas, and in October of the same year from the Cuddapah district in Madras.

In the case of Dehra Dun a considerable amount of damage was done both to tallow trees (*Sapium sebiferum*) and to tea. The caterpillars appeared shortly before the commencement of the rainy season and began by eating the leaves of the tallow trees. When these were stripped they let themselves down on to the tea bushes beneath and attacked them in a similar manner. Specimens were forwarded both from the Forest School and from Mr. Leslie Rogers. The latter noted that the caterpillar stage occupied from fifteen to twenty days and the pupal stage about ten days. The insect seems to have disappeared almost as suddenly as it came.

In the case of the Cuddapah district the insect was reported as doing a good deal of damage by defoliating castor-oil plants. The specimens from which the identification of the species was determined were furnished to the Museum through the Collector's office.

The identification of the mosquito.

Mr. F. A. Skuse, of the Australian Museum, Sydney, who has made a special study of Nemocera, has lately examined some specimens forwarded to him from the Indian Museum of the common brown mosquito of Calcutta. He identifies the species as *Culex pipiens*, Linn, said to have been introduced from Egypt, and now occurring throughout Australia, America, New Zealand and the old world. The fact is of interest, as the Indian form does not appear to have been previously identified with certainty. Representatives of the striped black and white mosquito, which is almost as great a nuisance in the day time, in Calcutta, as the brown mosquito is at night, have been forwarded to Mr. Skuse for favour of identification.(1)

(1) It has since been determined by Mr. Skuse as a new species of Culex for which he proposes the name *C. albopictus*. His description will be published in a subsequent number of these *Notes*.

Gram caterpillar.

In March 1893 caterpillars were forwarded to the Museum by the Deputy Commissioner of Betul, Central Provinces. They were reported as having proved destructive to gram(¹) during the cloudy weather, which had been prevalent in the district. The material proves insufficient for precise identification, but the insect is one of the Noctues. It may be noticed that the caterpillars of the specious *Heliothis amigera*, Hübn., sent to the Museum in 1889 from Patna, where they had been attacking *Lathyrus sativus* plants, are very similar in general appearance, though somewhat differently marked. They also tunnelled into the pods very much in the same manner. It is probable, therefore, that the two forms are somewhat nearly related to each other, though they are likely to represent distinct species.

Travancore teak-borer.

An imago of the insect referred to in volume I, page 198 of these *Notes*, as occasioning a considerable amount of damage by boring into teak trees in Travancore, was forwarded to the Museum in March 1893, by Mr. T. F. Bourdillon, who had successfully reared it from the caterpillar. The insect proves to be a Bombyces moth related to the family Cossidæ, but it is new to the Museum collection, so has been forwarded to Mr. F. Moore, who has made a special study of Indian Macrolepidoptera.(²)

According to an interesting note furnished by Mr. Bourdillon, the perfect insect would seem to emerge in the dry weather about March, and to lay its eggs shortly afterwards, for the borers are found from May onwards. Large caterpillars are also in some cases found at other times of the year, so it is likely that more than one season is sometimes passed in this stage. It is only softened, unhealthy wood that affords lodgement for the borer. Healthy trees appear to be quite free from its attack.

A Hesperid caterpillar injuring paddy.

In August 1892 specimens were forwarded by the Officiating Magistrate of Saran of an insect, known as "*Sapta*," said to have been causing much mischief to young paddy plants. The imago was reared in the Museum and proved to be a Hesperid butterfly. The specimens have been kindly examined by Mr. L. De Niceville, author of the *Butterflies of India*, who identifies them with some doubt as belonging to the species *Parnara colaca*, Moore. The excessive multiplication of this species appears to be somewhat unusual.

(¹) Probably *Cicer arietinum*.

(²) It has since been examined by Mr. Moore who identifies it as allied to his *cossus cadambæ*, Moore.

Orange tree defoliator.

Defoliation of orange and lemon trees in Dehra by the caterpillar of the butterfly *Papilio polytes* was reported from the Forest School in October 1892, and is worthy of record as confirming the observation that the injury to these plants is not confined to the one species *Papilio erithonius,* Cram. The identity of the species was ascertained by comparison with a carefully-named series of Indian butterflies presented some years back to the Forest School by the Trustees of the Indian Museum.

Longicorn-borers in the Punjab.

Specimens of a large wood-boring insect, which has been identified as the Cerambycid *Neocerambyx holosericeus,* Fabr., were forwarded in December 1892 by the Director of Land Records and Agriculture, Punjab. They were procured by the Deputy Commissioner of Dera Ismail Khan in November 1892. According to the account furnished, the insect is to be found in trees growing in dry places and specially in the " Farash(1)" but also in the " Sarin(2)" and " Kikar(3)." It is known as *Dain* in Hindi and *Raniah* in Pushtu. It generally attacks the trunk near to the ground, but the branches also suffer occasionally. The affected portion of the tree can usually be recognized by a swelling in the bark.

The species has previously been sent to the Museum as associated with other Cerambycidæ in attacking young teak trees in the Kulsi plantation of Assam, so is likely to frequent many kinds of wood.

Babul-borer.

A longicorn-borer, received from the Conservator of Forest, Berar, was forwarded to the Indian Museum in July 1892 by the Director of the Imperial Forest School, with the information that it does considerable damage to babul (*Acacia arabica*) plants. The larva is said to enter the stem some three or four inches above the ground, and to tunnel through the root to such an extent as eventually to cause death. The species is new to the Museum collection of Cerambycidæ ; it would seem to be nearly related to the genus *Cœlosterna,* but has been sent to Europe for further examination.(4)

(1) *Tamarix articulata* ?

(2) Botanical name not ascertained.

(3) *Acacia arabica.*

(4) It has been kindly examined by Mr. C. J. Gahan of the British museum, who identifies it as rather a small male example of the species *Celosterna (sic) spinator,* Fabr. Mr. Gahan notices that this species should be placed as a variety of *C. scabrator,* Fabr., which only differs in having the pubescence of the elytra more tawny or brownish in colour.

The preservation of books from insects in India.

In April 1893 information was called for upon the subject of the destruction of books by insects in Calcutta, and as the matter is one of general interest, it may be useful to notice what was ascertained. The most troublesome insect in Calcutta libraries appears to be a minute Ptinid beetle, which agrees with the description of the species *Sitodrepa panicea,* Linn. This cosmopolitan book-maggot drills pin holes through and through the cover and body of a book, and often completely disintegrates it. The only other insects which have been noticed as causing any considerable damage are white ants (*Termes* sp.) and cockroaches (*Periplaneta americana,* Deg.). They first devour the books wholesale, but are easily prevented from gaining access to them by placing the shelves upon the stone insulators commonly in use, while the second merely deface the bindings, so are of less importance.

The treatment recommended for use in the library of the Revenue and Agricultural Department was that of disinfecting the books by pouring a few teaspoonfuls of refined mineral naphtha, or what is known as benzine collas, into the crevices of the binding, and then shutting up the volume for a few days in a close-fitting box to prevent the escape of the fumes. Books so dealt with to be afterwards sponged over lightly with a very little of the finest kerosine oil, which should be rubbed off with a cloth before it has time to penetrate into the binding. This renders the books to a great extent distasteful to insects without causing serious injury. It is objectionable on account of the odour of the kerosine oil, but has the recommendation of harmlessness combined with considerable efficiency.

Particulars have since been obtained, through the kindness of the Superintendent of the Royal Botanical Gardens, Sibpore, of a system which has been adopted for preserving books in that institution. The treatment has been in use for a number of years, apparently without accident, and Dr. George King reports very favourably upon its effects. It consists in brushing the books over with a saturated solution of corrosive sublimate made by constantly keeping a few lumps of the poison at the bottom of the jar of alcohol (presumably the ordinary methylated article which has a strength of about seventy or eighty per cent.), so that the maximum amount may be absorbed. Great care should of course be taken in handling the corrosive sublimate on account of its exceedingly poisonous nature.

It may be useful to add that in the Indian Museum Library, where the books are kept in close-fitting glass-cases with a few ounces of naphthaline upon each shelf, little or no damage is caused by insects. From a note furnished by Mr. R. Chapman, late Librarian, it appears that the paste used in binding the Indian Museum books is poisoned by

adding about half an ounce of sulphate of copper to each ℔ of paste, while books already infested are disinfected by shutting them up for four or five days in a close-fitting box of loose naphthaline with as much of this substance as possible between the leaves.

Groundnut pests.

The following insects found attacking groundnut plants (*Arachis hypogæa*) in the neighbourhood of Panruti, South Arcot, were forwarded to the Museum in October 1892 by the Deputy Director, Land Records and Agriculture, Madras:—

(1) *Múdupúchi.*—This insect is said to be the most serious pest. It affects large areas and materially arrests the growth of the plant. A good shower of rain appears to remove it. Further information is promised. The specimens forwarded comprise larvæ and pupæ of a microlepidopterous insect which cannot be determined precisely without an examination of the imago.

(2) *Verpúchi.*—This insect is said to occur only in isolated patches, and is chiefly injurious in times of drought. It devours the fibrous roots of the groundnut plant and bites off the end of the tap root. Plants attacked by it are killed outright. It occurs in most fields, but is not common. The Shiyali taluq, where groundnut cultivation is comparatively recent and the soil sandy, is said to be to a great extent exempt from it. The pupal case of what would seem to be a Noctues moth was forwarded in connection with this insect, but the material is insufficient for the determination of the species.

(3) *Kambilipuchis.*—These insects are said to appear in large swarms in times of drought. They pass *en masse* from field to field completely defoliating the plants. An imago was reared in the Museum from a pupa forwarded, and proves to be an Arctiid moth of the genus *Aloa*. The specimen differs in markings, and is somewhat smaller in size than the typical *Aloa lactinea*, Cramer, but is likely to be merely a somewhat abnormal representative of this common defoliating species.

(4) *Pachaipulu.*—This insect is said to devour the leaves of the groundnut plant, but is usually rare. The material proved insufficient for determination.

(5) *Kalippuchi.*—This insect is said to defoliate groundnut plants to a small extent, also to commit serious ravages on raggi and gingelly crops. The specimen forwarded is an Acridid grass-

hopper of the genus *Crotogonus*, which is a common pest throughout India.

To the above may be added an insect known locally as *Elapuchi* reported as having caused some very slight damage by eating the leaves of groundnut plants in Villupuram (South Arcot) in September 1892. The specimens forwarded to the Museum by the Deputy Director of Agriculture, Madras, consisted of Curculionidæ beetles belonging to a species which seems to be allied to the genus *Episomus*. The insect is as yet undetermined in the Museum collection, and has been sent to Europe for further examination.(1)

Cremastogaster dohrni, Mayr.

Specimens of an ant belonging to the genus *Cremastogaster* were sent to the Museum in January 1893 by Mr. E. E. Green, of Ceylon, with the information that it had proved very troublesome in cinchona and coffee plantations. The insect was forwarded to Prof. A. Forel, who has kindly examined it, and who identifies the species as *Cremastogaster dohrni*, Mayr, a form which occurs throughout Ceylon, India, and Sumatra.

The following particulars are taken from an interesting note furnished by Mr. E. E. Green :—The ants construct their large dark-brown nests—sometimes more than two feet in diameter—on the stems of the cinchona and Grevillea trees, or on the branches of the coffee, and resent intrusion. They have no stings, but the bites they inflict are so severe that it is almost impossible for coolies to work in the immediate neighbourhood. The nest seem often to be originally started around a colony of plant lice, either of the species *Lecanium coffeæ* or *Dactylopius adonidum*. The presence of the ants causes a good deal of damage to the trees, as the portion above where the nest is situated often dies off, the branches below remaining unaffected. The breaking up of a nest only disperses the colony and increases the evil, for in a very short time a number of smaller nests take the place of the original.

Scarabæidæ.

Amongst the Scarabæidæ forwarded to the Museum since the issue of the last number of these notes, may be noticed :—

(1) Imagos of the species *Serica pruinosa*, Burm. (Melolonthini), forwarded in June 1892 from Devikulam, 5,000 to 6,000 feet in the Madura district of the Madras Presidency, by Mr. A. W. Turner. The insect is reported to have done a considerable amount of damage by defoliating coffee bushes.

(1) It has since been identified through the kindness of Mons. Desbrochers des Loges, who determines it as *Episomus Crenatus*, Dej.

(2) Images of the species *Clinteria confinis*, Hope, forwarded in July 1893 by Mr. E. J. Buck. The insect was noticed as attacking peach and apricot trees in Simla.

Miscellaneous.

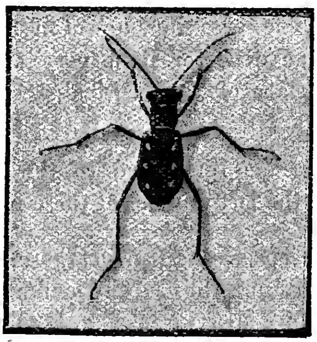
Workers of the ant *Dorylus longicornis* were forwarded in October 1892 by Mr. E. E. Green, with a suggestion that this species might possibly be the one referred to on page 42 of volume II of these *Notes* as attacking potatoes.

Specimens of a small red ant, which appears to be identical with the workers of the species *Monomorium basale*, Smith (Myrmecidæ), as determined in the Museum collection, were forwarded in April 1893 by the Deputy Commissioner, Betul, Central Provinces, with the information that they had multiplied to such an extent in the town of Badmir as to have become a great nuisance to the people.

The Curculionid referred to in volume II, page 12 of these *Notes*, as attacking young opium plants in the North-West Provinces, has been identified through the kindness of Mons. J. Desbrochers des Loges as belonging to the species *Tanymecus indicus*, Faust., MS.

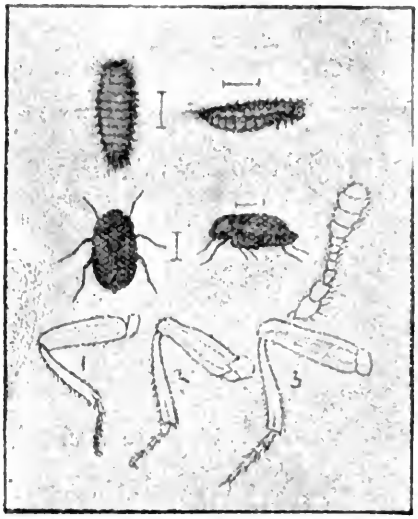
In March 1893 imagos of the Dermestid *Anthrenus vorax*, Waterhouse, which has previously been noticed as attacking skins in the Museum, were forwarded by Mr. L. de Niceville, with the information that they had proved destructive to some of the fittings in railway carriages on the Great Indian Peninsula Railway.

Indeterminable chrysomelid larvæ were forwarded in July 1892, by Babu N. G. Mukharji, as attacking potato plants in Berhampore.

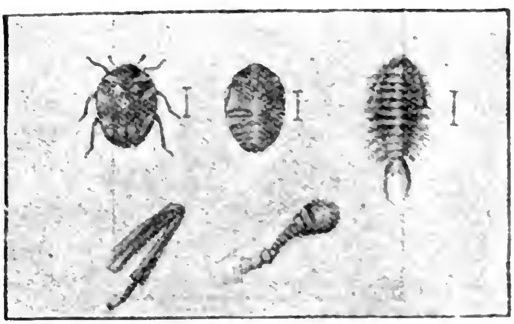


The above figure represents the tiger beetle *Cicindela sexpunctata* Fabr., natural size. This insect is referred to in volume I, page 59, volume II, page 148, and volume III, page 17, of these *Notes*. It

is a predaceous species, and is said to perform useful service in destroying the rice sapper *Leptocorisa acuta*, which does an enormous amount of damage to paddy (*Oryza sativa*) throughout India.

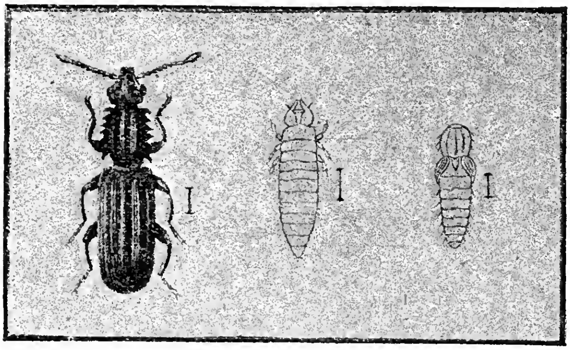


The above figure represents the larva and imago, both somewhat enlarged, of the Dermestid *Æthriostoma undulata*, Motsch. Below the imago are much enlarged diagrams of the antenna and of the first, second and third pairs of legs, the latter numbered 1, 2, and 3, respectively. The natural size of the insect is shown by hair lines. This species is referred to in these *Notes*, volume I, page 61, volume II, page 48, and volume III, page 23. It is known as *Kapra* in the Delhi bazar, where it is said sometimes to destroy as much as six or seven per cent. of wheat stored in godowns.

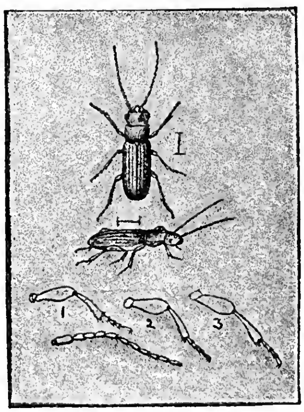


The above figure represents the larva and imago, both enlarged, also

much magnified diagrams of the antenna, and one of the legs of the Dermestid *Anthremes vorax*, Waterhouse. The natural size of the insect is shown by hair lines. This species is referred to in these *Notes*, volume I, page 208, and volume III, page 118. It attacks skins and leather of all kinds, and is a troublesome Museum pest in India.

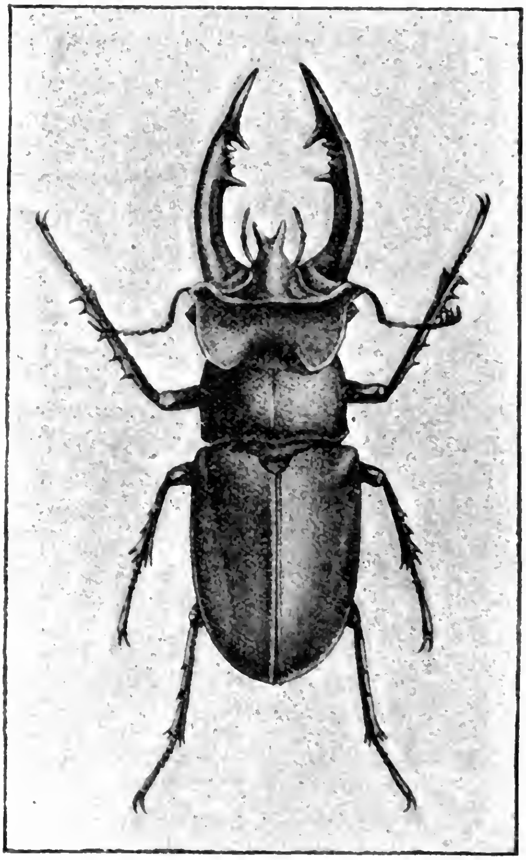


The above figure, which is after Curtis, represents the larva, pupa, and imago of the Cucujid *Silvanus surinamensis*, Linn. The natural size of the insect is indicated by hair lines. This species is referred to in these *Notes*, volume I, page 60, and volume II, page 148. It is a common warehouse pest in India, where it has been noticed as attacking both dried fruit and also farinaceous substances.

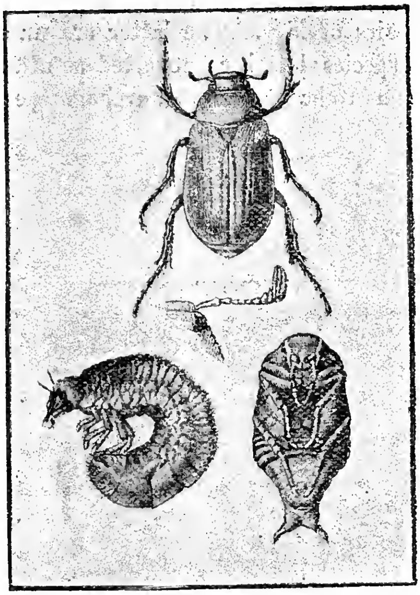


The above figure represents the imago of the Cucujid *Læmotphlœus*

pusillus, Fabr. The natural size of the insect is indicated by hair lines. Below are given enlarged diagrams of the antenna and of the first, second, and third pairs of legs. The latter are numbered 1, 2, and 3, respectively. The species has been reported as attacking ships' biscuit in Calcutta, and seems to be a common warehouse pest.

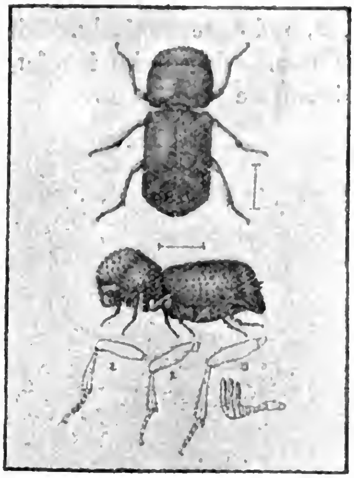


The above represents the Lucanid *Lucanus lunifer*, Hope, male, natural size. This insect is referred to in volume II, page 148 of these *Notes*. It has been reported as destructive to oak trees in the Himalayas.

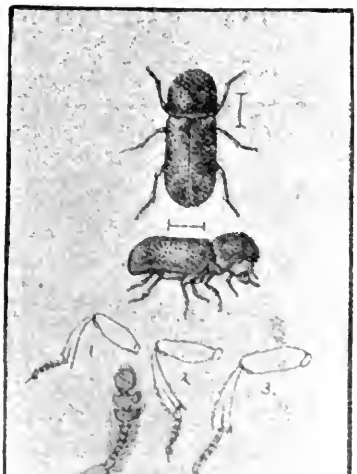


The above represents the Melolonthid, *Lachnosterna impressa*, Burm., in various stages of development, all natural size, also the side of the head in the imago, enlarged, to show the structure of the antenna. This species has been reported as extremely destructive in tea gardens in Sikkim. It is referred to in these *Notes*, volume I, page 59, volume II, page 149, and volume III, page 3.

The above is the Buprestid *Chrysobothris sexnotata*, Gory, natural size. Its larvæ are said to bore into sâl timber. *Vide* these *Notes*, volume II, page 119.

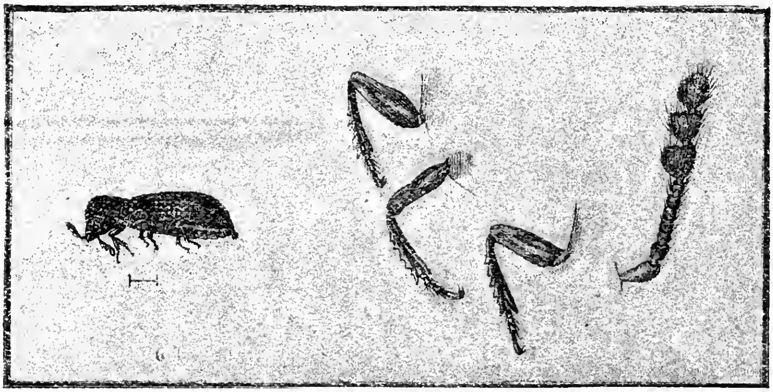


The above is a species of Ptinidæ, probably belonging to the genus *Sinoxylon*. It has been reported as tunnelling into the wood of the tree *Terminalia belerica*. The figure shows the imago enlarged, also much magnified diagrams of the antenna, and first, second, and third pairs of legs. The latter are marked 1, 2, and 3, respectively. The insect is noticed in these *Notes*, volume III, page 22.

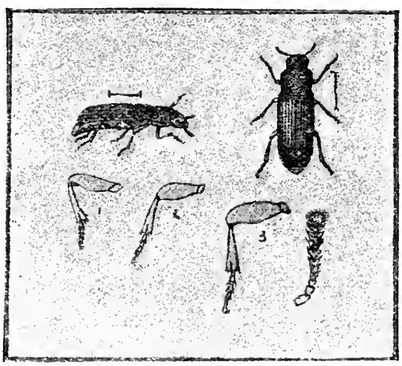


The above represents the destructive bamboo borer *Dinoderus sp.* (*Ptinidæ*). The figure shows the imago enlarged, also much magni-

fied diagrams of the antenna and first, second, and third pairs of legs, the latter numbered 1, 2, and 3, respectively. The natural size of the insect is shown by hair lines. The species is referred to in these *Notes*, volume I, page 43, and volume II, page 150.

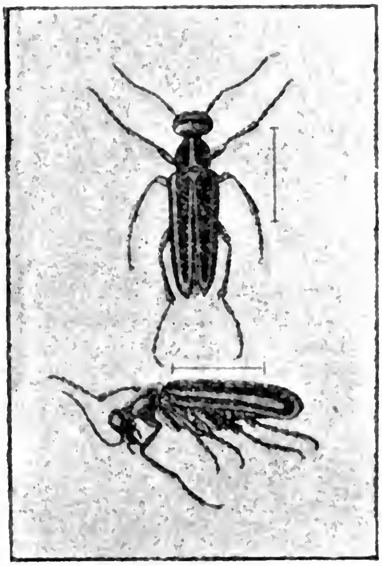


The above represents the imago of the Ptinid *Rhizopertha pusilla*, Fabr., enlarged, also much magnified figures of the legs and antenna. The natural size of the specimen delineated, which was obtained from Sialkot wheat, is indicated by a hair line. The insect attacks wheat, cholum seed, and other farinaceous matter. It is referred to in these *Notes*, volume I, page 60, and volume II, pages 27 and 150.



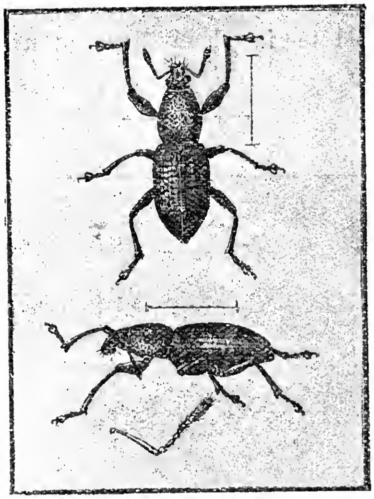
The above represents the Tenebrionid *Tribolium ferrugineum*, Fabr. The figure shows the imago enlarged, also much magnified diagrams of the antenna and first, second, and third pairs of legs, the latter marked 1, 2, and 3, respectively. The natural size of the insect is indicated by

hair lines. The species is a common museum and warehouse pest in India. It is referred to in these *Notes*, volume I, page 60, and volume II, page 150.

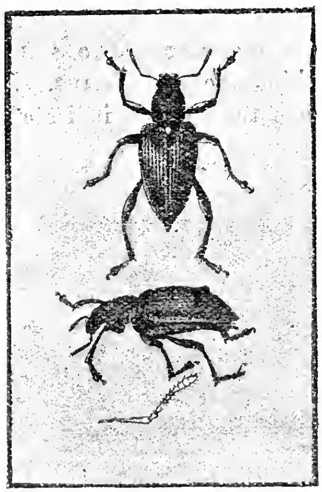


The above represents the imago of a Cantharid beetle, which has been reported as attacking crops in Meerut. It has not yet been identified. The natural size of the insect is indicated by hair lines.

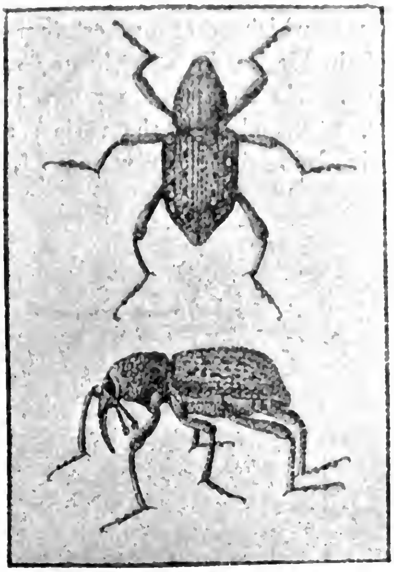
The above represents the larva and pupa, both enlarged, of the Curculionid ***Apion strobilanthi***, Desbroch. The natural size of the specimens is indicated by hair lines. This insect is referred to in these *Notes*, volume II, pages 32 and 151, the imago being figured on page 32. It attacks the plant *Strobilanthus pectinatus* in Sikkim.



The above represents the imago of the Curculionid *Astycus lateralis*, Fabr., enlarged, with much magnified figure of the antenna. The natural size of the insect is indicated by hair lines. The species is referred to in these *Notes*, volume I, page 58, and volume II, page 151. It has been reported as attacking various plants in different parts of India.



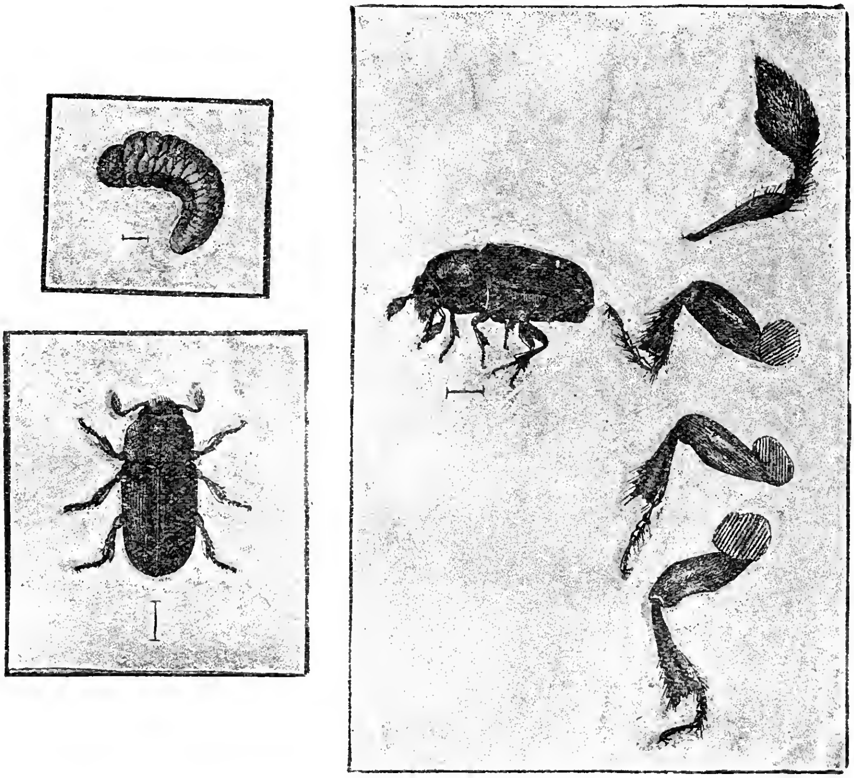
The above represents the Curculionid *Astycus chrysochloris*, Wied., natural size, with magnified figure of the antenna. This insect has been reported as attacking tea plants in Cachar. It is referred to in these *Notes*, volume III, page 99.



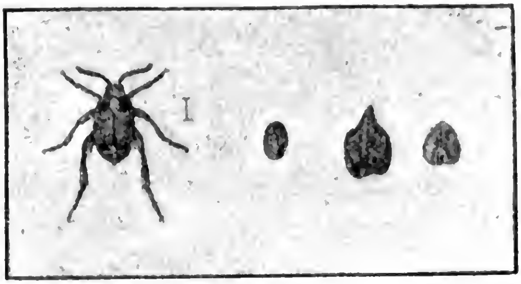
The above represents the imago of the Curculionid *Sipalus granulatus*, Fabr., natural size. This insect is referred to in these *Notes*, volume II, page 151. Its larvæ are said to bore into *Butea frondosa* timber.

The above is reduced from a figure in Mr. H. N Ridley's report on

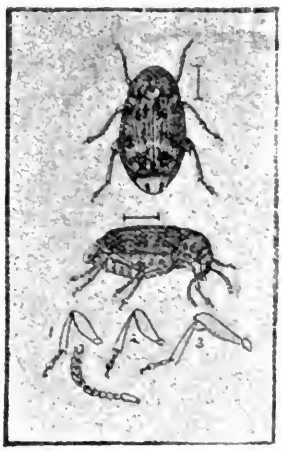
the *Destruction of Cocoanut palms by Beetles*, Singapore, 1889. It shows the dilapidated appearance which a cocoanut estate presents when suffering from the attack of the beetles *Rhynchophorus ferrugineus*, Oliv., and *Oryctes rhinoceros*, Linn. These insects are referred to in these *Notes*, volume II, pages 8, 9, 149, and 151, the various stages of *Rhynchophorus ferrugineus*, Oliv., being figured in volume II, page 8.



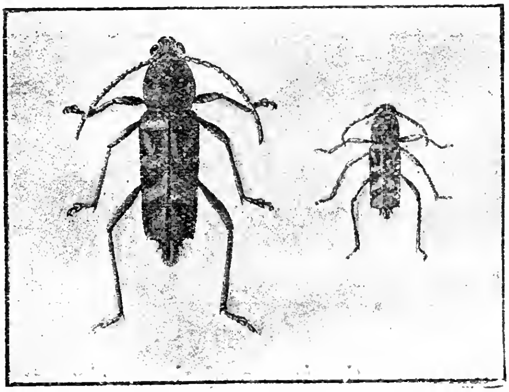
The above represents a species of Scolytidæ belonging to the genus *Polygraphus* (allied to *P. pubescens* of Europe), which has been reported as tunnelling into the bark of *Pinus excelsa* trees in the North-West Himalayas. The figures show the larva and imago enlarged, also much magnified diagrams of the antenna and legs of the beetle. The topmost leg is the front one.



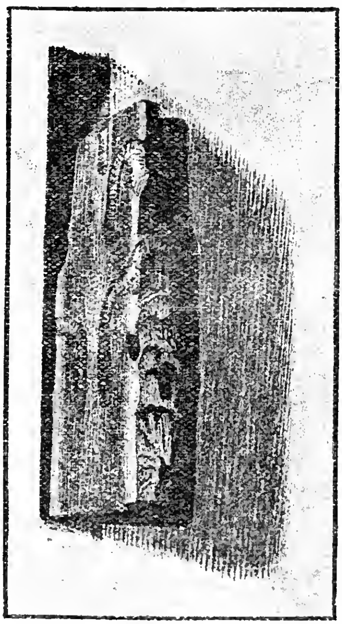
The above represents the imago of the species *Bruchus chinensis*, Linn., enlarged, also the seeds (natural size) of various leguminous plants it attacks. The natural size of the insect is indicated by a hair line. The species is referred to in these *Notes*, volume I, page 209, volume II, page 152, and volume III, page 25.



The above represents a beetle which has been identified as *Bruchus emarginatus*, Allard. Var. The figure shows the imago enlarged, also much magnified diagrams of the antenna and first, second, and third pairs of legs, the latter numbered 1, 2, and 3, respectively. The insect attacks the seed of the *Pisum sativum* plant. It is referred to in these *Notes*, volume I, page 209, and volume II, page 152.

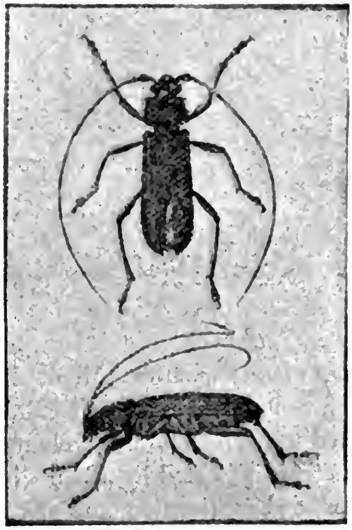


The above represents the imago of the longicorn *Xylotrechus quadrupes*, Chevr., both natural size and enlarged. Its larva does much damage by tunnelling into the stems of coffee bushes. The insect is referred to in these *Notes*, volume I, page 61, and volume II, page 153.



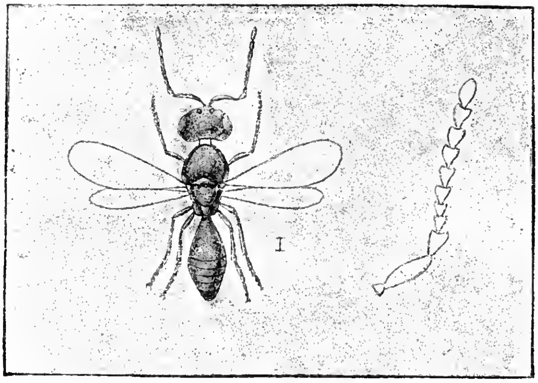
The above represents a block of sâl timber, one-seventh natural size, which has been tunnelled by the larvæ of the Longicorn *Plocederus*

obesus, Gahan = *P. pedestris,* Cotes. This insect is referred to in these *Notes,* volume I, pages 60 and 91, and volume II, page 153.

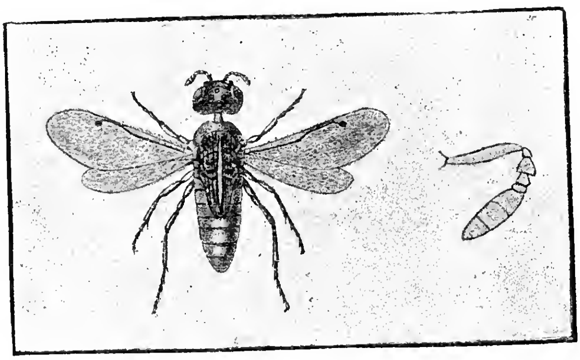


The above represents the imago of the Longicorn *Stromatium barbatum,* Fabr., natural size. The specimens delineated were reared from khair wood. The species has also been recorded as attacking teak and other timber. It is referred to in these *Notes,* volume I, page 59, and volume II, pages 12 and 153.

The above represents a worker, natural size, of the jungle honey bee *Apis dorsata,* Fabr. This insect builds large single combs in the open, and stores considerable quantities of inferior honey. It is referred to in these *Notes,* volume II, page 39.

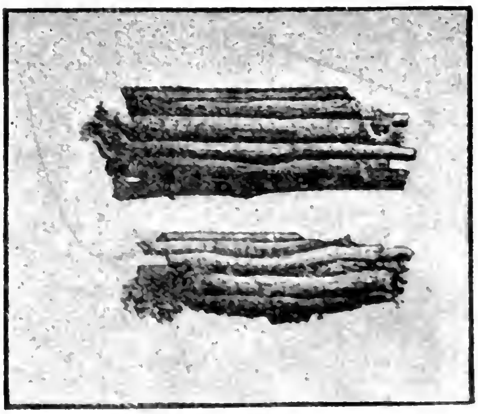


The above figure, after Cameron (Mem. Proc., Manchester Lit. and Phil. Soc., vol. IV, 1890) represents the Proctotrupid *Platygaster oryzæ*, Cameron, referred to in these *Notes*, volume II, page 156. The natural size of the insect is indicated by a hair line. To the right is a much enlarged diagram to show the structure of the antenna.

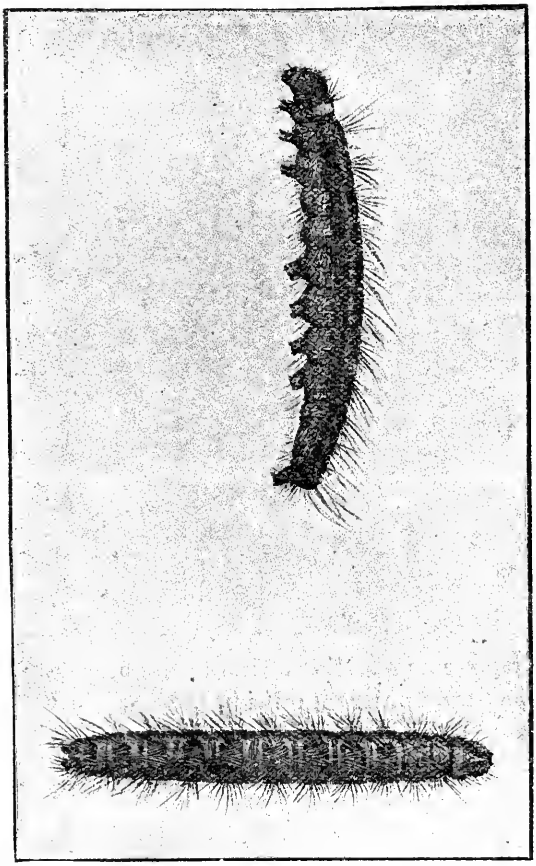


The above figure after Cameron (Mem. Proc. Lit. Philos. Soc., volume IV, 1890) represents the minute Chalcid *Aphelinus theæ*, Cameron, referred to in these *Notes*, volume II, page 155. The insect is less than half a millimetre in length. To the right is a much enlarged diagram to show the structure of the antenna.

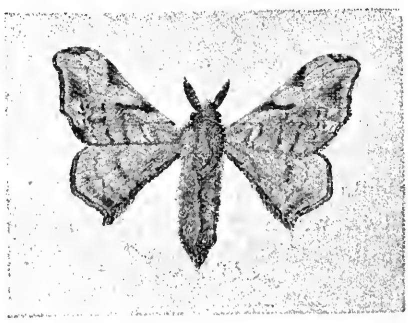
The above represents a section of the trunk of a young poplar tree from Baluchistan, one-tenth natural size, to show the tunnels made by the larva of the Aegeriid moth *Sphecia ommatiæformis*, Moore. This insect is referred to in these *Notes*, vol. II, pp. 14 and 156.

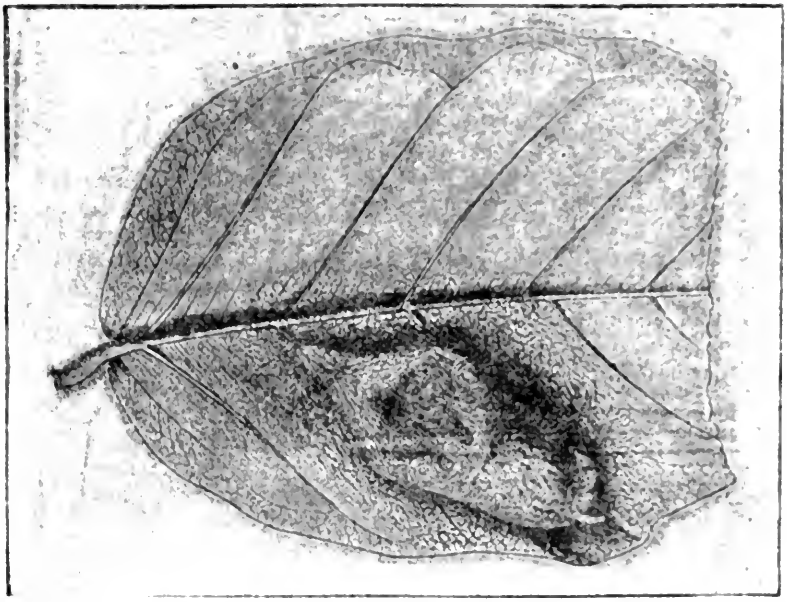


The above represents the larval case, natural size, of the bag worm *Eumeta crameri*, Westw., which defoliates tea and other plants. The insect is referred to in these *Notes*, volume I, page 204, and volume II, page 157.

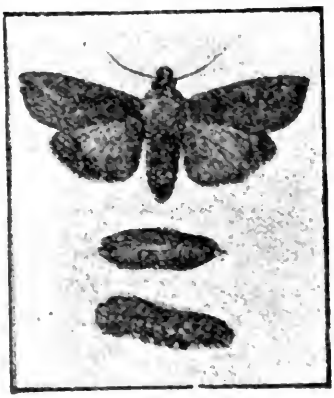


The above represents the caterpillar (natural size) of the species *Spalyria minor,* Moore, which has been reported as defoliating various plants in Burma. The insect is referred to in these *Notes,* volume II, page 159, and volume III, pages 20 and 89. Figures of the imago, male and female, appeared in volume III, page 89.



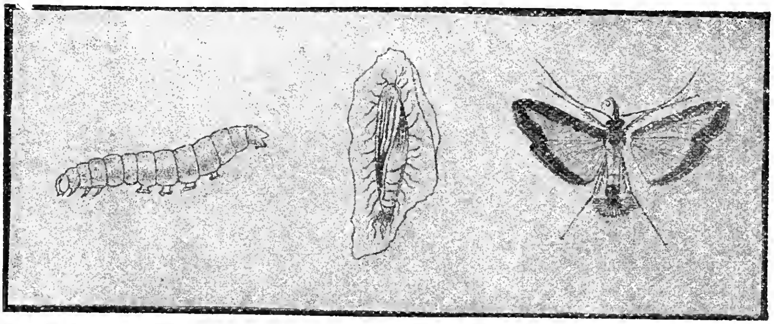


The above represents the male moth, also part of a leaf with pierced cocoon, both natural size, of the wild silk moth *Aristhala sikkima*, Moore. This insect is referred to in these *Notes*, volume II, page 89. It has since been forwarded to the Museum from Cachar, where it was found attached to the leaves of the peepul tree (*Ficus religiosa*). The cocoon is glistening white in colour, in shape and structure not unlike the cocoon of a polyvoltine mulberry silk worm, and containing a good deal of remarkably fine silk.

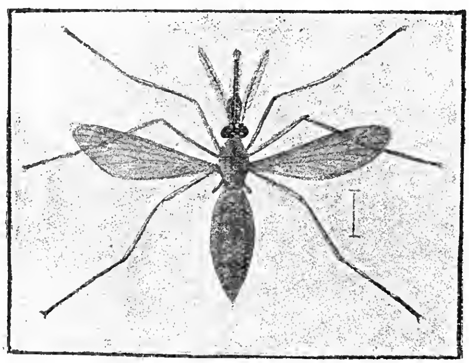


The above represents the Noctuid *Leucania extranea*, Guen., in various

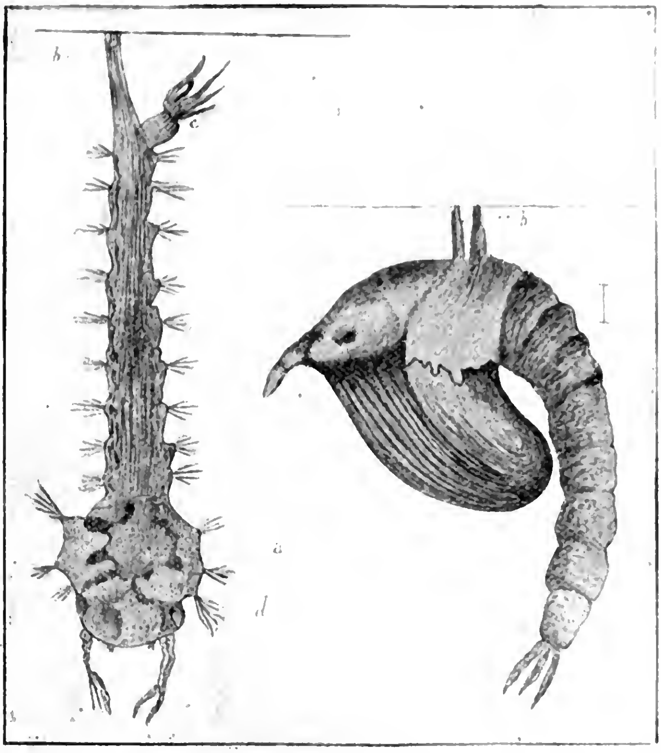
stages of development, all natural size. This insect is referred to in these *Notes*, volume I, page 108, and volume II, pages 5, 10, and 160. It has been reported as destructive to various plants in Bengal.



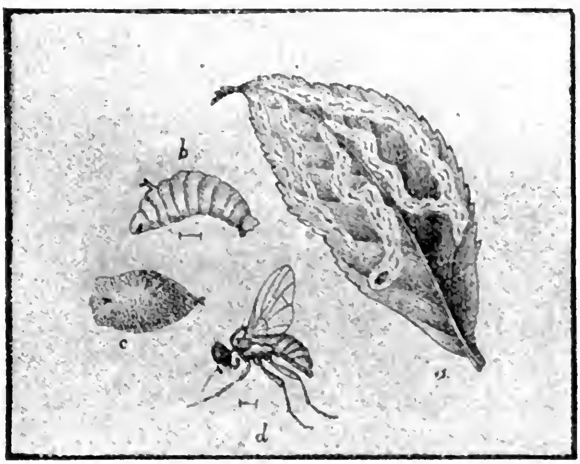
The above represents various stages in the life history of the Micro-lepidopterous insect *Eudioptes indica*, Saunders (after Saunders figures Trans. Ent. Soc., Lond., 1850-51). The species was described as defoliating cotton plants in Java, and is likely also to occur in India. It is referred to in these *Notes*, volume II, page 162.



The above represents the female imago enlarged, of the brown mosquito (*Culex pipiens*, Linn.). This insect is referred to in these *Notes*, volume III, page . The natural size is indicated by a hair line.

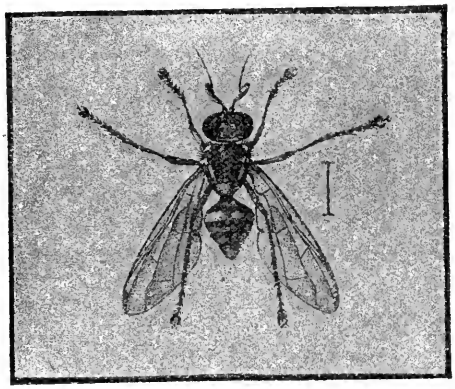


The above represents the larva and pupa, much magnified, after Gilchrist of the species *Culex pipiens*, Linn.

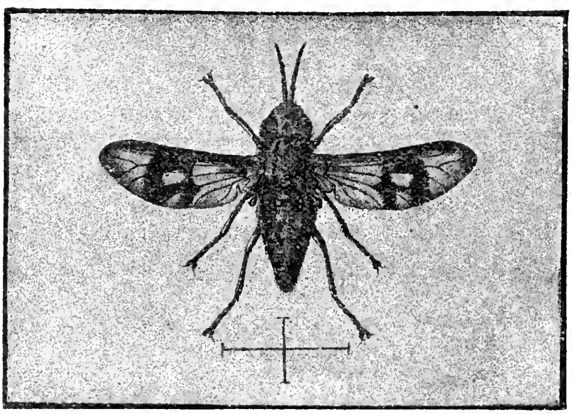


The above is from a drawing furnished by Mr. E. E. Green of

Ceylon. It represents the tea leaf miner *Oscinis theae*, Bigot. The following is an explanation of the figure :—a, tea leaf reduced, to show the tunnel made by the larva; b and c, larvæ enlarged ; d, imago enlarged. The natural size of the insect is indicated by hair lines. The species is referred to in these *Notes*, volume I, page 204, and volume II, page 165.

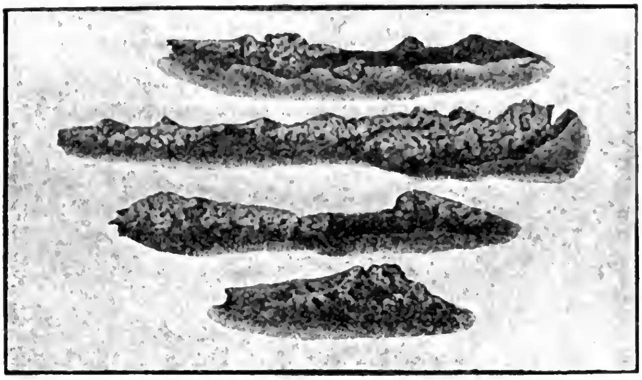


The above represents the imago of the Muscid *Rivellia persicæ*, Bigot. The larva of this insect have been reported as attacking peaches in Chota Nagpur. The species was first described in these *Notes*, volume I, page 192. Notes on its life, history appeared in the same volume, page 195. The natural size of the insect is indicated by a hair line.

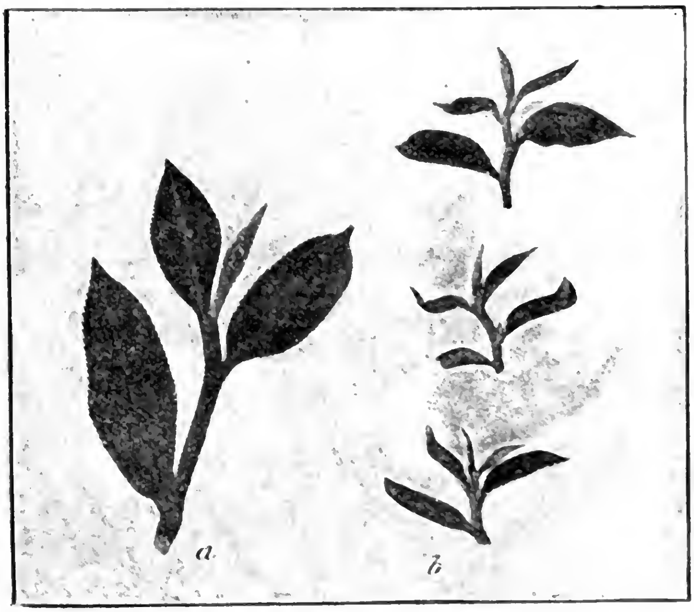


The above represents the imago of the Tachinid *Chrysops dispar*, Fabr., which has been reported as troublesome to cattle in Baluchistan.

The insect is referred to in these *Notes*, volume II, page 10., The natural size is indicated by hair lines.

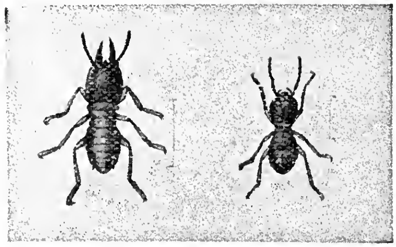


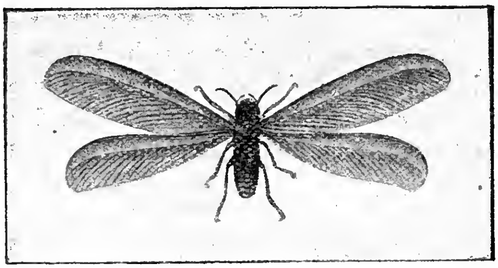
The above represents apple twigs, one-third natural size, from the Nilgiri Hills, showing the curious excrescences produced by the attack of the Aphid *Schizoneura lanigera*, Hausmann. This insect is referred to in these *Notes*, volume I, page 208, and volume II, pages 13, 52, and 167.

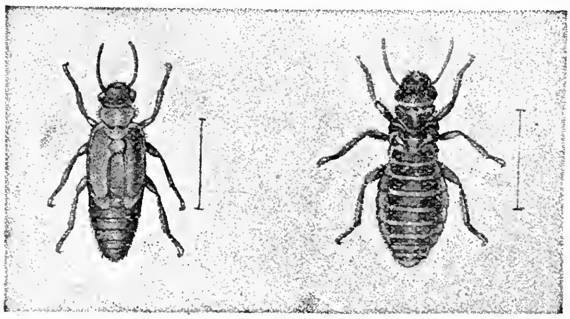


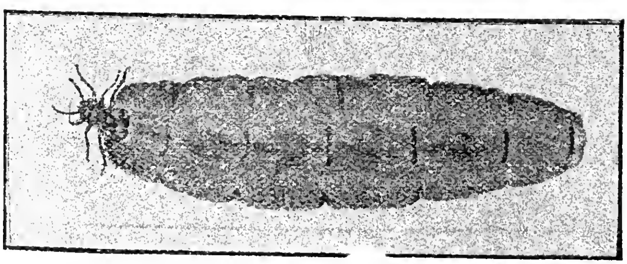
The above shows the result of the attack of the Green Fly Blight

Chlorita flavescens, Fabr., upon tea shoots. All the figures are drawn half natural size. The sprig marked (*a*) is an ordinary healthy tea shoot, while those marked (*b*) are shoots of the same age but suffering from the attack of the *Chlorita*, which dwarfs their growth and renders them useless for tea making. The insect is referred at length in these *Notes*, volume III, page 9.









The above represents various stages in the life history of the common white ant of Lower Bengal, *Termes taprobanes*, Walker. The first block represents the soldier with large mandibles, also the worker with small mandibles: the natural size in each case is indicated by a hair line. The second block represents the winged form natural size. The third block represents the full grown larva with budding wings, also the fertilised female after it has dropped its wings and returned to the nest, but before its abdomen has expanded to any very considerable extent. The natural size in each case is indicated by a hair line. The fourth block represents the female, natural size, after it has attained its full growth in the nest. The species is referred to in these *Notes*, volume II, page 172, and volume III, page 23.

G. I. C. P. O.—No. 178 R. & A. D. 5-4-94. 1,000.

Vol. III.] [No. IV.

INDIAN MUSEUM NOTES.

AN ACCOUNT OF THE INSECTS AND MITES WHICH ATTACK THE TEA PLANT IN INDIA.

By E. C. COTES,

Deputy Superintendent of the Indian Museum.

CONTENTS.

PREFACE.

In January 1894, at the instance of the Hon. Mr. James Buckingham, C.I.E., Chairman of the Assam branch of the Indian Tea Association, a letter was addressed to the Trustees of the Indian Museum by the Government of India, in the Revenue and Agricultural Department, suggesting the desirability of publishing in a collected form the information already brought together in the Indian Museum upon the subject of tea blights. The matter was favourably received by the Trustees, and the following report has been drawn up under their instructions.

Attention was first directed to the insects and mites which attack the tea plant in India by Mr. S. E. Peal, then a tea planter in the Sibsagar District of Assam, who published a valuable paper on "mosquito blight" in the Journal of the Agricultural and Horticultural Society of India, Vol. IV, 1873. Mr. Peal described the effect of mosquito blight and warned the planting community of the extent of the injury likely to be occasioned by it. He further traced the insect through its various stages of development subsequent to emergence from the egg. In 1881 the late Mr. James Wood-Mason, at that time Deputy Superintendent of the Indian Museum, was deputed to Assam to investigate the matter. Mr. Wood-Mason's report appeared in 1884. In it he confirmed Mr. Peal's observations on the subject of mosquito blight, and added an account of the egg which he was the first to discover. He also traced the mite popularly known as "red spider" through its transformations upon the tea leaf.

Numerous other species have since been complained of by tea planters as causing injury to the bushes, and from time to time specimens have been sent to the Indian Museum with inquiries as to their indentity.

Some years since the study of the matter was taken up by the writer of this note as part of an extended investigation of the insects which attack crops generally in India. At first, owing to the unarranged condition of the general entomological collections of the Indian Museum, very few of the species that were forwarded in connection with injury to crops could be determined. Little by little, however, the collections have been largely arranged and the identity of the more important species ascertained.

The investigation of the habits and life-histories of the various insects, including the whole practical side of the question, has had to be confined to what could be ascertained, without leaving the Museum, from specimens and reports furnished by planters and other residents in the localities affected. This method of inquiry was very desirable in the first instance in order to ascertain the nature and scope of the outbreaks which would require investigation. It has been only an initial step, however, and taken by itself is necessarily inadequate. The cordial co-operation of many of those concerned, who have not only made observations themselves upon the lines suggested to them, but frequently forwarded living specimens in such condition that they could be kept under observation in rearing-cages in the Indian Museum, has enabled a surprising amount of information to be collected. The limit of useful work to be accomplished through this agency has now been to a large extent attained, and the results arrived at require, for their further elaboration, extensive and prolonged investigations which can only be carried out effectively in the field, where all the concomitant circumstances can be inquired into.

The prospect of further advance is a hopeful one, provided means can be found of carrying on the investigation upon a scale commensurate with its importance. Already, the information collected in connection with the habits and life-histories of many of the species is sufficient to indicate the possibility of adopting methods or treatment which have done wonders in dealing with corresponding forms in other parts of the world. Some of these methods have already been experimented upon with promising results in India, and are likely eventually to be adopted upon a large scale. Others have been suggested, but not yet taken up, while a third class have hitherto hardly so much as reached the ears of the great majority of the planting community.

In particular the insecticides, both liquid and gaseous, and the various forms of apparatus for applying them, now in general use in the United States, are worthy of special attention, while a field is open for the cultivation of beneficial parasitic forms, seemingly as promising as that which has yielded results of the greatest practical value against fluted scale in California.

The only sound basis for investigations directed to the prevention and mitigation of insect ravages lies in the careful study of the habits and life-histories of the species concerned. Researches in the field and in the laboratory, however, must not be divorced from each other, but must go hand in hand, supported by practical experiments upon a scale sufficient to exclude error. This has been the system adopted in the United States with the result of saving a very appreciable portion of the enormous damage previously caused by insect blights; and there is no apparent reason why similar procedure in India should not be productive

of similarly useful results, especially where such valuable crops as tea, indigo, and coffee are concerned.

The following report is intended to show the stage which the inquiry has reached in the case of the tea plant. It has been drawn up with a view both to facilitate reference to what has already been ascertained, and also to indicate the directions in which further research is desirable.

The record of the inquiries conducted in the Indian Museum has been kept in the pages of the periodical *Indian Museum Notes.* The report, therefore, is chiefly based upon this publication, supplemented where possible from the papers of other observers who have frequently been in communication with the present writer upon the subject of their inquiries.

Amongst works from which help has been received, special reference may be made to an admirable series of papers by Mr. E. E. Green, originally published in nineteen instalments in the *Ceylon Independent* in 1889. In these papers Mr. Green describes his observations on a number of species which attack the tea plant in Ceylon. Most of the insects he describes have also been recorded from India, and are therefore discussed fully in the following pages. Others again have not hitherto been recorded from India, so are merely alluded to briefly, the reader being referred for further particulars regarding them to Mr. Green's work, which should be in the hands of all interested in the subject.

In his recent work on the *Chemistry and Agriculture of Tea,* Calcutta, 1893, Mr. M. K. Bamber makes a number of suggestions, many of them of much practical value, for dealing with the various blights which attack the tea plant. The chapter which he devotes to the matter is arranged on the same plan as that adopted in the present report, his remarks, indeed, upon the entomology of the subject being in many cases transcribed from *Indian Museum Notes.* His recommendations, therefore, can easily be consulted by those concerned and, as his work will no doubt be in the hands of most Indian tea planters, it has been considered unnecessary to do more than refer to it in this place.

[When not otherwise acknowledged the figures in the following report have been drawn from the specimens by native artists in the Indian Museum, the majority being the work of Babu G. C. Chuckrabutty. Many of them have previously appeared in illustration of papers by the writer in the pages of *Indian Museum Notes.* With two exceptions the wood-cuts have been prepared by Messrs. West, Newman & Co., of London.

Owing to his absence from India the writer has been unable to revise the final proofs of this report; it is hoped, however, that the typographical errors which escape correction will not be of importance.]

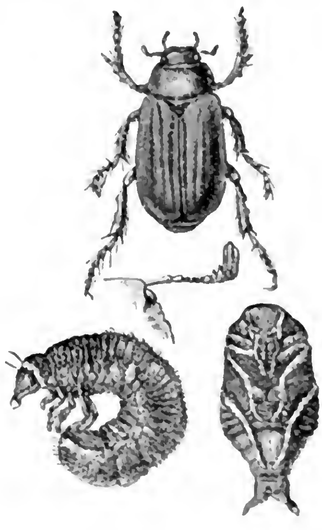
THE TEA INSECTS OF INDIA.

INSECTA.

COLEOPTERA.

Meloronthini.

Lachnosterna impressa, Burma—(= White grub). The larva (*i.e.* immature form) of this insect is the soft, white, curved grub shown in the left hand bottom figure. In 1891 it appeared in vast numbers in some of the Darjiling tea gardens, and made great havoc among young tea plants. In one garden it is reported (*vide Indian Museum Notes*, Vol. III, page 3) to have practically destroyed 100 acres of young tea as fast as it was planted. Its prevalence in other years is shown by the fact that in 1883 no less than 2,695,000 individuals were collected and destroyed in the public gardens, Darjiling, alone (*vide Indian Museum Notes*, Vol. I, page 59).



From what is known in connection with the habits of insects of the same sub-family in other parts of the world we can be practically certain that the life-history of *Lachnosterna impressa* is somewhat as follows:—

The beetle, a brown insect, depicted natural size in the upper part of the block, mates with another individual of the opposite sex, but otherwise almost exactly like itself. The female shortly afterwards lays

its eggs on the ground. From these eggs emerge small curved white grubs armed with powerful jaws with which they bite off the roots of plants. These grubs never quit the ground. They moult at intervals and gradually grow bigger until they become of the size shown in the left hand bottom figure, or even bigger than this. They then moult their skins for the last time and transform into white motionless creatures (or pupæ), one of which is depicted, natural size, in the right hand bottom figure. The pupa lies dormant for a time in the ground, and then its skin splits down the back, and out of it emerges the beetle which makes its way out of the ground. The beetle flies about for a time and perhaps eats a few leaves, but its chief object in life is to find a mate and to become the parent of another generation. Thus the circle goes on continuously.

With regard to the time spent by the insect in its various stages of growth all that we know is as follows. A number of nearly full-grown grubs, sent to the Indian Museum, Calcutta, from Darjiling in October 1891, remained in the earth at the bottom of the breeding-cage in which they were kept, until the following February, when a beetle emerged. This shows that the insect passes the cold weather in the ground, for in the moist warm climate of Calcutta it is certain to develop at least as fast as in the hills, and possibly considerably faster. The beetle of a species belonging to the same family has been noticed by the writer emerging in large numbers from the ground, on the Calcutta *maidan*, in the latter part of the hot weather, so the probabilities are that the hot season is the usual time for emergence. Under these circumstances the eggs would be likely to be laid about the beginning of the rainy season in Northern India; but this point requires confirmation. How long is spent by the grubs in the ground before they become full grown we do not know, but the fact that the European species *Melolontha vulgaris*, Fabr., spends more than three years in this stage,[1] while the American species *Macrodactylus subspinosus*, Fabr., spends the greater part of one year,[2] leads to the supposition that an equally long period may be required in India. Much, no doubt, depends upon the climate of the locality; for warmth and damp are almost certain to accelerate development, whereas dryness and cold retard it. In any case, a generation of the insect is almost certain to occupy one year, and it is quite possible that it takes two or even three years to complete.

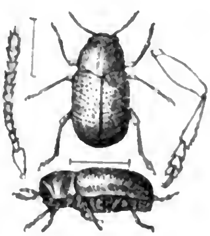
On Ceylon coffee estates, where Melolonthini larvæ at one time proved very troublesome, the only method of treatment that seems to have been at all successful was digging out the grubs by hand; and this, though very costly, was generally admitted to be the most satisfactory method of dealing with the pest.

[1] Ormerod. [2] Packard.

Attempts have recently been made in Europe to destroy the grubs of an allied insect by inoculating them with the spores of a fungoid disease to which they are subject. This method of treatment, however, has not hitherto yielded any practical results, so cannot be recommended. In the case of a species which attacks the roots of vines in Europe, bisulphide of carbon is said to have been used with some success, but the writer is not in a position to say whether it is likely to be of any use in India. The simplest method of applying it is said to have been to make a hole near the main root of the vine by forcing a small stick into the earth, then to pour about half a teaspoonful of bi-ulphide of carbon into the hole, and plug it with earth pressed down by the foot.

CHRYSOMELIDÆ.

Diapromorpha melanopus, Lacord—(Orange beetle). This insect has been reported from Sibsagar, Assam, as eating the stems of tea shoots, so that they wither and droop (*vide Indian Museum Notes,* Vol. I, p. 106). It is bright orange yellow in colour, and has hence been dubbed the "Orange beetle."



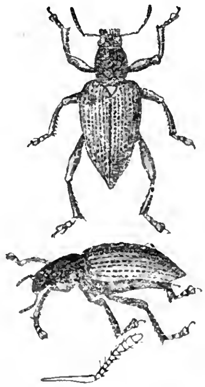
The wood-cut shows the beetle as it appears from above and also from the side, both enlarged, also much magnified diagrams of the antenna and of one of the legs. The size of the insect in nature is indicated by the hair lines which show the length measured from the head to the posterior portions of the elytra.

The species is a common one in India. The Indian Museum possesses specimens from Sikkim, Sibsagar, Birbhum, Murshedabad, Sahibganj, Calcutta, and Malda. It belongs to a family of leaf-feeding beetles, so any damage that it may do will no doubt be of the nature of defoliation. Nothing seems to have been recorded in India upon the subject of its transformations. From what is known of other species of the same family, it may be expected that the eggs are laid upon the leaves, that the larvæ are active little creatures which feed upon the foliage, eventually transforming, in some sheltered corner, into stationary pupæ from which the beetles ultimately emerge. These points, however, require corroboration. It would be useful also to ascertain the period spent by the insect in its various stages of development at different times of the

year, the number of annual generations, and the plants other than tea which it attacks.

CURCULIONIDÆ.

Astycus chrysochlorus, Wied. This beetle was sent to the Indian Museum in April 1892 from a tea garden in Cachar, where it was supposed to have been the cause of some injury to the bushes.

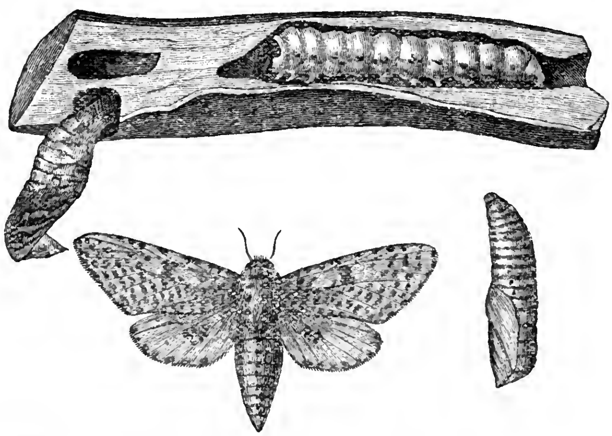


It was said to strip the young leaves off the tea shoots, but nothing further is known of its habits. The block shows the beetle, natural size, with enlarged figure of its antenna. The insect is covered with tiny scales, which give it a light greenish lustre.

LEPIDOPTERA.

COSSIDÆ.

Zeuzera coffeæ, Nietner—(Red borer[1]). The larva of this moth is a reddish grub, which tunnels into the stems not only of tea bushes, but also of coffee bushes and young sandalwood trees.



[1] White borer of Hampson.

The figure shows the moth and pupa, also a little piece of stem containing a full-grown caterpillar, and an empty pupal case protruding from the tunnel, as it appears after the moth has emerged. The specimens from which the figures are taken were reared in the Indian Museum from infested sandalwood stems from Mysore.

Caterpillars thought to belong to the same species have been sent to the Museum from tea gardens both in Darjiling and in Jorhat.

The insect was originally described in connection with coffee by Nietner in his pamphlet on the enemies of the coffee tree in Ceylon, 1861. The following is an extract from S. Green's edition of Nietner's work, page 14 (Colombo, 1880) :—

"This insect . . . . destroys many trees, young and old, the caterpillar eating out the heart : for this purpose it generally enters the tree six or twelve inches from the ground, ascending upwards. Fortunately it is not abundant. It resembles the caterpillar of the goat-moth of England, is two inches long, and as thick as a goose-quill, nearly naked, of yellowish colour, back red, head thoracic, and anal plates blackish ; when full-grown the colours are light and dirty. The sickly, drooping foliage, and a heap of globules of conglomerated wood-dust at the foot of a tree soon indicate that the caterpillar is carrying on its destructive work inside. The chrysalis rests three months, and its skin half protrudes from the hole when the moth escapes, which is about February. The moth measures $1\frac{3}{4}''$ across the wings, which are white, spotted with steel blue ; the upper ones, with one large spot and numerous series of small ones, placed in rows between the nerves; the lower wings are less spotted. Thorax with four spots near margin. Abdomen variegated with blue. Legs blue, second pair with white femora, third pair with white femora and tibiæ."

An excellent account of the insect in connection with tea has lately been given in a paper by Mr. E. E. Green, which appeared in the *Ceylon Independent*. According to Mr. Green's observations it is by no means uncommon on tea estates in Ceylon, though the damage which it does is often ascribed to other causes, as the caterpillar is very completely concealed in the interior of the stem. The female moth lays her eggs in the bark, and the young caterpillars tunnel their way into the heart of the wood. They are generally found in the first instance in the smaller twigs, but as they grow bigger they make their way into the main branches and stem, and sometimes kill young tea bushes down to the ground. When full grown they transform into chrysalids in the burrow. Mr. Green adds that the presence of the insect may usually be detected by the heaps of sawdust-like excrement to be found on the ground under the bush.

The chief points which remain to be ascertained in connection with the life-history of the insect are the dates of emergence and the periods of time spent by it in the egg and larval stages. In the case of coffee Mr. Nietner observed that the moth emerges about February, and it is noticeable that a moth reared in the Indian Museum in 1892 from sandalwood, forwarded to Calcutta from Mysore, also emerged in this

month. Mr. Green, however, notices that he has found moths at several other times of the year in Ceylon, so it would appear that the insect does not invariably emerge in February. The European species *Cossus ligniperda*, Fabr., which belongs to the same family, is said to spend as much as three years in the larval stage, and it is not unlikely that *Zeuzera coffeæ* will prove to be nearly equally slow in development, though, as a general rule, insects develop more rapidly in India than in Europe.

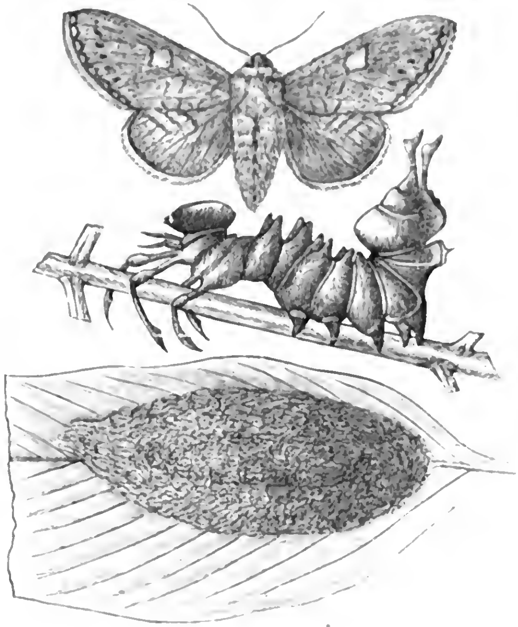
With regard to remedies, cutting out infested stems seems to be the most promising treatment that has been suggested, though the damage occasioned appears to be seldom sufficient to make this worth while. In the case of coffee bushes Dr. Bidie remarks (*Report on the ravages of the borer in coffee estates*, Madras, 1867):—"If not much injured, the external opening should be closed with a wooden peg, which causes the death of the borer, and the tree will then in all probability recover." Squirting kerosine oil into the hole or hooking the grub out with a barbed wire would also be likely to be effective in cases where the trouble was worth taking.

NOTODONTIDÆ.

Lobster caterpillars.

Stauropus alternus, Walker. The caterpillar of this species has been recorded by Green as occasionally feeding on the leaves of the tea plant in Ceylon. It has also been noticed as feeding on cocoa and *Cassia fistula*. As in the case of other members of the same family, the caterpillars are curious hump-backed creatures with long legs. Bamber notices that they are found in Darjiling, and as the species is one that occurs throughout India, besides inhabiting Ceylon, it may appropriately be included in the present report.

The figure, which is after Moore, shows the moth, larva, and cocoon, all natural size.



The caterpillar spins a cocoon amongst the leaves, and Green records that the pupal stage lasts for two or three weeks. The eggs are likely to be laid upon the tea plant, but neither the locality of ovi-position nor the number of generations in the year seems as yet to have been ascertained.

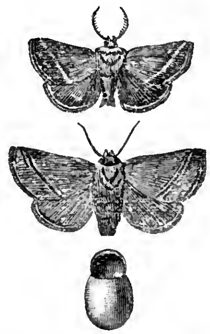
LIMACODIDÆ.

Limacodidæ caterpillars (nettle grubs) have been reported as attacking tea alike in the Dooars, Assam, and Ceylon. They feed upon the foliage and can be recognised by their curious slug-like appearance. They are mostly brightly coloured and armed with urticating spines which are capable of inflicting an unpleasant sting. When full grown, the caterpillar forms around itself a curious potato-like case which is a very characteristic feature of the family. Here it transforms into a chrysalis, from which, after a period of repose, the moth emerges. The species hitherto recorded as attacking the tea plant are as follows:—

(1) Thosea (Miresa) cotesi, Swinhoe. Pupal cases very similar to those of this species, but insufficient for precise identification, were sent to the Indian Museum in October 1889 from a tea garden in the Dooars where they had been found upon tea bushes.

The species itself was afterwards described by Colonel Swinhoe from

moths reared in the Indian Museum from caterpillars forwarded from Durrang in January 1891. In Durrang the caterpillars were reported as having defoliated tea bushes and when full grown descended to the ground to pupate. Children had been employed to hand-pick the caterpillars, but the insect had proved too numerous to be dealt with successfully in this way. Some difficulty also was experienced in hand-picking owing to the stinging spines with which the caterpillars were armed.



The figure shows the male, female moths, also the empty pupal case, all natural size, drawn from specimens reared in the Indian Museum. The pupal case is depicted with the upper portion pushed up, like an open lid, as it appears after the moth has emerged.

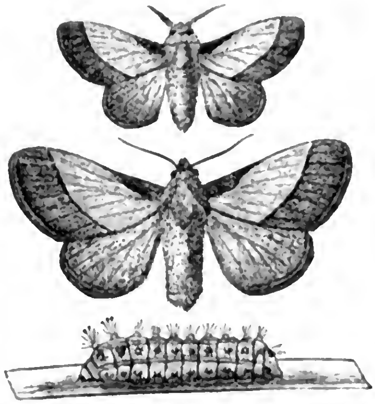
With regard to the times of emergence, all that has yet been observed is as follows:—Full-grown caterpillars, sent to the Indian Museum from Durrang in January, transformed into pupæ the same month, moths emerging on 26th January. From its activity in the coldest month of the year and the short period spent in the pupal stage, the insect would seem likely to pass through a number of generations in the year, but more extended observations are required.

Parasa lepida, Moore. This species has been recorded by Green as attacking tea in Ceylon. It has previously been noticed, under the name *Limacodes graciosa,* by Nietner as defoliating coffee bushes in the same island. It has also been reared in the Indian Museum from caterpillars found feeding upon mulberry leaves in Calcutta. The Museum further possesses specimens from Ranchi. The insect has also been recorded from Java, so is probably widely distributed.

In the case of the specimens reared in the Indian Museum, the caterpillars were found in September, but the moth did not emerge until June in the following year, the intervening eight months being spent in the pupal case. This long period of hybernation does not appear to be an invariable feature of the life-history of the species, for Nietner, writing in connection with Ceylon, observes "the chrysalis rests from

the middle of August to the middle of October." A probable supposition is that the insect passes through several generations in the year, the length of time spent in the chrysalis stage being liable to protraction when warmth or moisture, or both, are deficient.

The fact that Nietner only records the presence of the caterpillars upon Ceylon coffee bushes between the months of June and August points to the possibility of at least occasional hybernation even in that island.



The figure above, which is after Moore, represents the male and female moth, also the caterpillar, all natural size. The moths are brownish in colour with bright green markings. The caterpillar is greenish with mauve stripes; the sting which its spines are capable of inflicting is described by Green as rather more intense than that of the common nettle. The cocoon is purplish in colour and is usually attached to the plant. Green describes the eggs as oval and almost transparent; he found them in masses of from fifteen to twenty on the back of the leaf, overlapping each other like the scales of a fish.

PSYCHIDÆ—(*Bag worms*).

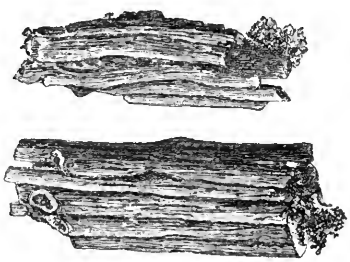
Several species of Psychidæ attack tea. The caterpillars, which are popularly known as "bag worms," may be recognised by the curious little cases of sticks or leaves which they carry about upon their backs. They injure the tea plant by eating up the foliage. The caterpillar enlarges its case from time to time as it grows bigger. When full grown it fastens its case with silken strands on to some twig or leaf. It then closes up the entrance in front and, after turning completely round upon itself inside the case, so that its head comes where its tail had previously lain, it moults its skin for the last time and transforms into a pupa (=chrysalis). After resting for a while, the pupa, which is armed

with curious backward set spines for the purpose, works for itself an opening in the loose end of the case. The pupal skin then cracks and the sexually mature insect emerges. The female is a degraded wingless grub which never quits the case. The male is an active winged moth which flies rapidly about and mates with the female as she lies inside the case. After mating, the male dies and the female proceeds to lay her numerous eggs inside the case.

The treatment that seems to be generally adopted upon tea gardens is that of collecting the cases by hand. As the eggs are laid inside the case, it is necessary to collect not only those which have caterpillars inside them, but also the old and apparently dead cases; for otherwise there will be fear of leaving cases full of live eggs from which young caterpillars may afterwards emerge in great numbers. As the female is incapable of flight, the only way that the insect spreads is by the caterpillars, which are very active, crawling from bush to bush. The evil, therefore, can easily be kept in check by a vigilance in picking off the caterpillars.

A small trench with a streak of coal-tar at the bottom is likely to be sufficient to prevent the insects from invading a garden from the neighbouring jungle. This they are always liable to do, for most of the species feed upon numerous other plants besides tea. The species hitherto recorded as attacking tea are as follows:—

Eumeta crameri, Westw. Caterpillars of this species have been sent to the Indian Museum on several occasions from tea gardens alike in Sikkim and Assam.

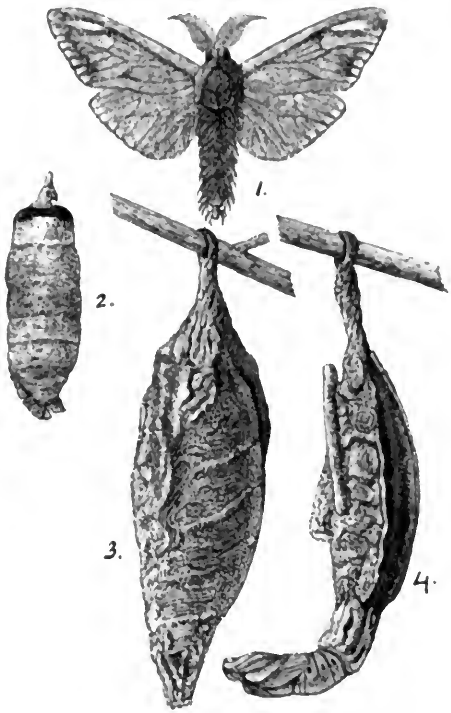


The insect has also been recorded by Green as feeding upon both tea and coffee bushes in Ceylon.

The cases, shown natural size in the figure, are like miniature fagots of sticks. The most remarkable feature about the caterpillars is their extraordinary vitality. Indeed, they will withstand an amount of rough handling which would be fatal to the larvæ of almost any other group of Lepidoptera. The point is an important one to remember in considering how best to dispose of what are brought in by coolies.

The chief points in connection with the insect which remain to be ascertained are the number of generations in the year and the periods passed in the various stages of development.

Eumeta sikkima, Moore. A very complete and interesting account of this insect has been given in the pages of *Indian Museum Notes* by Mr. G. C. Dudgeon, who found the caterpillars very generally upon sâl and less often upon tea in the Darjiling district.



The figure, which has been taken from specimens presented to the Indian Museum by Mr. Dudgeon, shows:—(1) the male moth; (2) the degraded wingless female as she appears when taken out of the case; (3) the larval case in which the female passes her existence; (4) the larval case of the male, with pupal skin protruding from which the male moth has emerged. The figures are all natural size.

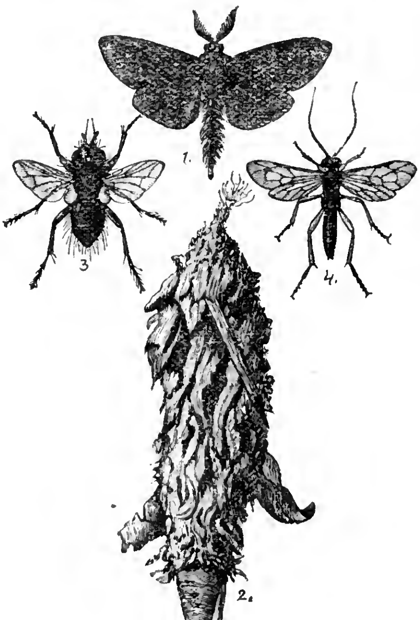
The following is an extract from Mr. Dudgeon's paper:—

"The larvæ emerge about the 1st of April from eggs laid at the beginning of March in the same year. This is the first brood of the year, but the others do not follow in any regularity, and it has been impossible for me to ascertain how many broods there are, as the larvæ and pupæ are found in all stages throughout the rains. Larvæ when first emerged are about one-sixteenth of an inch in length. Colour

reddish brown. Heads large, mandibles strong. Body cylindrical, tapering towards the tail end. Pectoral legs large, long, and very powerful; abdominal legs seen perfectly through magnifying glass, semi-developed, ten in number, including anal legs. Pectoral segments dorsally covered with a light brown shell-like covering. They do not seem to utilise the old cocoon in the construction of their own cases, and walk about for days with the abdominal segments always held perpendicular to the rest of the body. Some form cases about the third or fourth day from bits of moss and bark of sâl trees on the leaves of which they feed, but they constantly desert their cases at first. The larva feeds on the young leaves of the trees at this stage, but afterwards seems almost to prefer the old and tough ones. The larva never leaves its case after it has once begun to enlarge it, which it does by adding small bits of moss, leaves, flowers, stalks, and in one case the elytra of a beetle was used. The mouth of the case is always made flexible, so that when alarmed the insect can draw in its head and the mouth of its case as well."

Cases of a Psychid, which may perhaps belong to the same species, were sent to the Museum in 1888 from Ranchi, where they were said to appear chiefly in November and to infest tea, sâl, and other plants. The material in this case was insufficient for the absolute identification of the species.

Amatissa consorta, Templ. This insect was sent to the Museum as responsible for a good deal of damage to tea in the Darjiling district in the early part of the rains of 1893.



The specimens received in June were larvæ, but both males and

females emerged in the Museum before the rainy season was far advanced, so the period passed in the pupal stage must be comparatively short.

Several specimens of an Ichneumonid parasite, also a single Tachinid parasite, emerged in the rearing-cage in which the caterpillars were kept in the Museum. These parasites have not yet been precisely determined, but they both belong to groups of insects which lay their eggs upon caterpillars. From what has been observed in the case of other species we know that the grubs which emerge from these eggs cut their way into the caterpillar's body. Their victim may drag on a weary existence for some time afterwards, but invariably perishes in the end, without leaving offspring. The point is interesting as it shows that even the tough case in which the bag worm encloses itself is not sufficient to ensure it from the attack of these parasite forms, which, as will be shown under the heading of *Dasychira thwaitesii*, have a wonderful effect in keeping down some defoliating species of Lepidoptera in India.

The block shows—(1) Adult male of *Amatissa consorta;* (2) its larval case with empty pupal skin protruding; (3) Tachinid parasite; (4) Ichneumonid parasite.

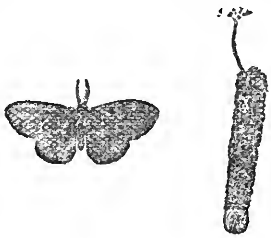
The figures are all drawn natural size.

Govisana bipars, Walker. An insect thought to belong to this species has been recorded by Dudgeon as feeding upon the tea plant in Darjiling. Dudgeon noticed that it completely strips the tea bushes it feeds on, and often kills them by taking off the bark to make its case. The figure is from a specimen of the male moth presented to the Indian Museum by Mr. Dudgeon.

Postscript.—A quantity of live caterpillar in various stages of development, which are thought to belong to the species *Govisana bipars,* Walker, have just been received from a tea garden in Assam where they are said to have killed a number of bushes down to the ground by eating off the bark—28th March 1894.

Babula sp. Bamber notices a caterpillar of this genus which "builds for itself a conical case from the epidermis of the leaves on which it lives." He adds—"I have only seen it on a few bushes in Assam, but these it completely defoliated, being present on the bushes throughout the whole season and preventing their flushing." The insect

may not improbably belong to the species *Babula grotei,* Moore (=*Acanthopsyche moorei,* Hampson), figured below.



The figure to the left represents the male moth, that to the right its larval case with empty pupal skin protruding. The figures are taken from specimens reared upon *Lagerstrœmia indica* leaves in the Indian Museum. The species has also been recorded as feeding upon babul.

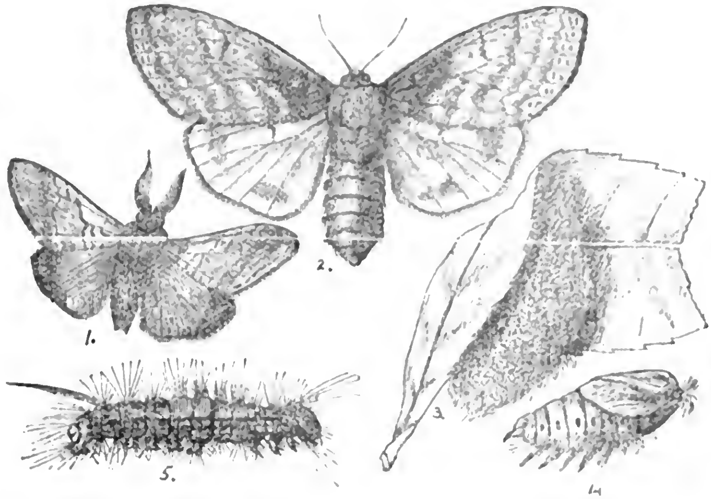
BOMBYCES, VARIOUS FAMILIES.

Dasychira sp. Caterpillars and cocoons of a species *Dasychira,* referred to in *Indian Museum Notes* under the specific name of *Dasychira thwaitesii,* Moore, were sent to the Indian Museum in February 1886 from a tea garden in the Dooars where they were said to have caused serious damage by feeding upon the leaves. The insect is thought to be identical with a species previously recorded by Fisher as having defoliated a large area of sâl trees in the Dooars in October 1878, where it also attacked tea and other plants.[1]

The caterpillar is covered with hair and has four thick tufts on the back which give it a somewhat characteristic appearance. When full grown it spins itself up between the leaves of the tea plant in a scanty cocoon composed chiefly of its own hair, which appears to be very easily detached. Here it transforms into a chrysalis. In the case of the February generation, which was the one kept under observation in the Indian Museum, the insect remained in the cocoon for rather less than a

[1] See *Indian Museum Notes*, Vol. I, p. 29.

fortnight. The number of generations in the year and the time spent in each of them has not yet been ascertained.



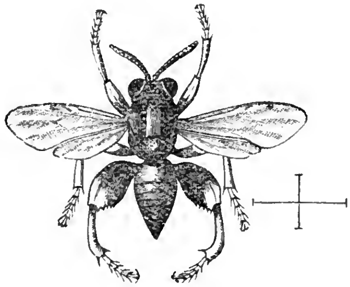
The figure above shows—(1) the male moth; (2) the female moth; (3) the cocoon partially enveloped in a tea leaf; (4) the chrysalis as it appears when extracted from the cocoon; (5) the caterpillar;—all natural size.

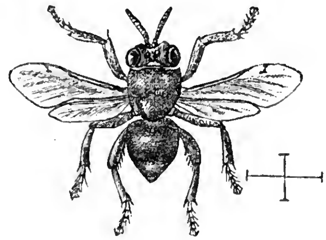
The most remarkable feature noticed about the insect was the extent to which it suffered from parasites. The number of live caterpillars and cocoons forwarded to the Museum was considerable, but so great was the mortality among them from this cause that very few moths could be reared. On the other hand, large numbers of Tachinid flies emerged in the breeding-cage, also two species of Chalcidæ. The Tachinid flies have been referred to the two species *Trycolyga bombycis*, Becher, and *Masicera dasychiræ*,[1] Wulp. The Chalcidæ have been identified as *Chalcis euplœa*, Westw., and *Perilampus sp.*

Both the Tachinid flies and also *Chalcis euplœa* are practically certain to attack the caterpillar. In the case of the *Perilampus* there is some doubt; indeed, from observations made by Howard in America upon other species of the same genus, it is probable that the insect is parasitic, not upon the caterpillar, but upon the Tachinæ. The question of the habits

[1] Of the four adult specimens preserved in the Indian Museum, three appear to belong to the species *Trycolyga bombycis*, Becher, and one to the species *Masicera dasychiræ*, Wulp.

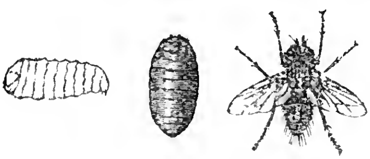
of the *Perilampus* is an interesting one, though the insect has not yet been found in sufficient numbers to be of any practical importance.





The wood-cut to the left shows *Chalcis euplœa* enlarged; that to the right shows the *Perilampus,* also enlarged. The natural size in each case is indicated by hair lines.

The most important parasites are undoubtedly the Tachinid flies, which would seem to act as a most effectual natural check upon the multiplication of this and other defoliating caterpillars in India. Their history requires very careful working out, as there are two forms concerned which superficially are almost indistinguishable from each other, though the specialist in Holland, to whom they have been submitted, looks upon them as representing separate species. The point is an important one to investigate, as one of the two species (*viz., Trycolyga bombycis,* Becher) is the well-known silk-worm fly which is very destructive to silk-worms in Murshedabad and elsewhere in Bengal.



The figure above shows *Trycolyga bombycis* on three stages of development, all natural size. To the left is the full-grown larva (maggot), in the middle is the pupal case, and to the right is the sexually mature fly. The habits of *Trycolyga bombycis,* as observed in the silk districts,[1] are briefly as follows :—The fly lays its eggs, one at a time, on the bodies of the caterpillars. One fly is therefore able to infect a large number of caterpillars. The egg hatches a few hours after it is laid, and out of it creeps a tiny maggot which bores its way into the body of the caterpillar. Here it lives and grows, feeding on the fatty tissues of its host

[1] See *Indian Museum Notes,* Vol. I, p. 83.

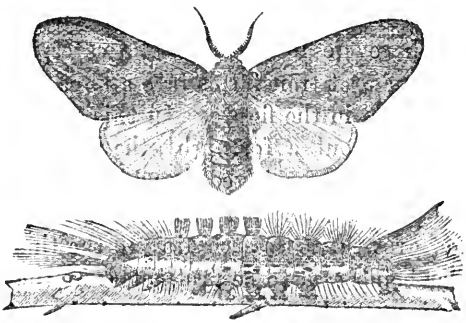
for about a week. The caterpillar in the meantime lives on and may even spin itself up into a cocoon. When full grown, the maggot, which now looks much like a grain of boiled rice, endowed with movement, cuts its way out of the caterpillar's body and crawls down to the ground, where it buries itself. In cutting its way out of the caterpillar's body it inflicts such severe injury that the caterpillar invariably dies. In the ground the maggot transforms into a pupa enclosed in the brown bean-shaped case shown in the figure. In this state, in warm weather, it remains inactive for about a fortnight, the pupal case then cracks and out of it emerges a full-grown winged fly which seeks a mate and becomes in a few days the parent of another generation. The period spent in the different stages of growth varies according to the time of year, the pupal stage in particular being said to be protracted, in the cold weather, to some months, during which period the insect hybernates.

Suggestions have been made for importing the silk-worm fly from the silk districts, in cases where defoliating caterpillars have multiplied excessively, and the experiment would seem to be well worth trying, though its success must depend largely upon the question, which has not yet been sufficiently investigated, of the relative importance of the part played by this particular species amongst the numerous forms which attack caterpillars in India. From recent observations, now in course of publication in the periodical *Indian Museum Notes*, it appears that *Trycolyga bombycis* attacks such different caterpillars as the mulberry silk-worm, the eri silk-worm, the tea *Dasychira*, and *Olene mendosa*, Hübn. In the case of the mulberry silk-worm, we know that a very few flies, when allowed unimpeded access, are able rapidly to destroy a very large number of caterpillars. Indeed, so much is this the case that the doors and windows in Bengal silk-rearing establishments have to be carefully protected by screens in order to keep out the flies. Where this precaution is not taken, the silk-worms are liable to be destroyed almost wholesale. Mukerji recounts how, upon one occasion, the fly destroyed ninety per cent. of a lot of silk caterpillars he was rearing in Berhampore, and his experience is a common one. It remains to be seen to what extent it can be turned to practical account.

Chalcis euplœa is likely to attack the caterpillar in a manner very similar to that adopted by *Trycolyga bombycis,* the only point of much practical importance in which it is likely to differ, being in the place of pupation, for Chalcidæ larvæ often pupate in, or close to, the body of their victim, instead of sheltering themselves in the ground as is the case with Tachinæ. The precise habits in this instance have yet to be ascertained by actual observation.

Olene mendosa, Hübn.—(=*Dasychira mendosa,* Hamp.) Caterpillars of this species were sent to the Museum in February 1890 from

Darjiling, where they were said to feed upon tea bushes. The figure shows the female moth, also the caterpillar, both natural size.



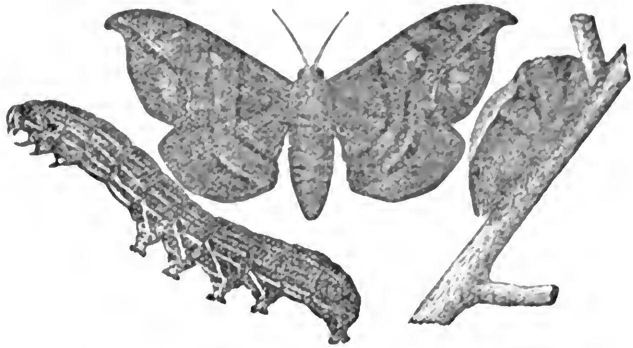
The figure of the moth is from a specimen reared in the Indian Museum, that of the caterpillar is after Moore. The male moth is a brownish creature not unlike the female, but differs in being very considerably smaller and in having pectinated antennæ. The caterpillar is covered with hair. One of the specimens sent to the Museum was found to be parasitized by the Tachinid *Trycolyga bombycis*, Becher. No further information has been obtained, but the insect is likely to have very similar habits to the *Dasychira sp.* described above.

Undetermined hair-covered caterpillar. The precise identity of this insect has not yet been ascertained. The following extract from a note by the writer (*Indian Museum Notes*, Vol. III, page 2) gives all that has yet been recorded about it:—

"In April 1891 specimens were furnished by Messrs. Andrew Yule & Co. of an insect which had proved destructive to tea (*Camellia theifera*) in the Jorhat district of Assam. The manager of one of the gardens wrote that he had been getting twenty-five 2-maund bags of these caterpillars picked off the bushes daily, but that in spite of all his efforts they seemed rather to increase in numbers. They stripped the leaves and the bark of the bushes to such an extent as in some cases to kill the plants. The manager added that during the ten years he had been in the district he had never seen such a visitation, and that his coolie sirdars, some of whom had been over twenty years on the garden, could not remember the like. The specimens that were forwarded were found to be the larvæ of a Bombyces moth which is thought to belong to the family Arctiidæ. The insect does not appear to have been previously sent to the Museum as attacking tea, and it cannot be identified precisely without an examination of the moth into which the caterpillar transforms."

Andraca trilochoides, Moore. The caterpillars of this species (= *A. bipunctata*, Hampson) were reported in 1893 as doing a good deal of damage by defoliating tea bushes both in Cachar and Jorhat. The

figure shows the moth, the catterpillar and the cocoon, all natural size from specimens forwarded to the Indian Museum :—



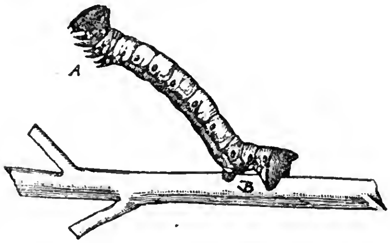
The first specimens that reached the Indian Museum were forwarded from Cachar in January 1893. The insect continued prevalent in Cachar for some time subsequent to this date, and was again sent to the Museum in September 1893 from Jorhat. In Cachar, according to the information forwarded, the bushes that were attacked were not situated in blocks, but were scattered here and there through the tea. In many cases they were said to have been completely defoliated, and the nature of the damage that was occasioned may be judged from the fact that in one garden alone in Cachar, in the six months ending May 1893, it was found worth while to spend some fifteen hundred rupees in employing coolies to pick the insects off the bushes. In this case no less than sixty-nine and a half maunds weight of caterpillars were said to have been destroyed—a goodly quantity when it is remembered how voracious is the appetite of each individual insect.

Moths emerged in the Museum in March and from caterpillars received in February from Cachar. From caterpillars again, forwarded to the Museum from Jorhat in September, moths emerged in October. This would seem to indicate that development goes on throughout both the rainy season and the cold weather, the number of generations in the year being, no doubt, numerous. The cocoon is a loose silken structure attached to the twigs of the tea plant, so in habits the insect is likely to resemble the *Dasychira* described above.

Geometres.

In July 1890 an obscure Geometrid caterpillar was forwarded to the Indian Museum from Nowgong, Assam, where it was said to have been attacking tea bushes. The material furnished was insufficient for the precise identification of the species, and as the insect has not

subsequently been complained of, it is not likely to be of very much importance.



The figure shows the caterpillar, natural size. The specimen was kept for some time in alcohol before the drawing was made, so the figure is not a very satisfactory one, though it gives the essential features of the insect.

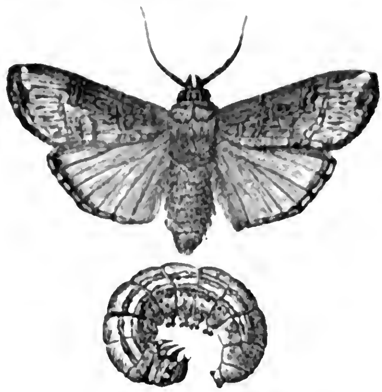
Caterpillars of the group Geometres can be recognised by their peculiar mode of progression. They have the anterior pairs of prolegs rudimentary and the remainder set far back, while the body is slender and elongated. Owing to this peculiar structure they are able to step along with considerable rapidity, by holding the ground first with the little jointed legs (A), at the front end of the body and then with the prolegs (B), at the posterior end, while they alternately hump up their bodies and stretch them out to their full extent. Geometres caterpillars are on this account popularly known as loopers. They all feed upon leaves. When full grown, the caterpillar transforms into a chrysalid whence the moth afterwards emerges. The moths of the various species are very different from each other in appearance, but most of them are slender creatures with large weak wings. The males have flat comb-shaped antennæ, the females have slender thread-like antennæ. The species which feeds upon tea has yet to be determined and traced through the various stages of its development.

Noctues.

Agrotis suffusa, Fabr. This cosmopolitan insect is one of a number of allied species which do much damage to crops in all parts of the world.

It has been recorded by Green as attacking young tea plants in Ceylon, where its caterpillar is known as "black grub." It has not actually been sent to the Indian Museum in this connection from any Indian tea garden, but it has frequently been reared by the writer from caterpillars sent to the Museum as attacking other crops in India, and it represents a group of insects with one or more of which the Indian tea planter is very likely to be troubled. It has been reported as attacking various crop plants in Kurseong, Jessore, Murshidabad, Tipperah, Ghazipur,

Fatehgarh and Behar, and as specimens have also been captured by entomologists in Kulu, Solun, Sikkim, Calcutta, Mhow, Poona, and Quetta there can be no doubt about its prevalence throughout India.



The figure shows the moth, and the full-grown caterpillar, both natural size, the former from a specimen in the Indian Museum, the latter after Riley. The caterpillar is a soft dark-coloured grub which lives in a hole in the ground in the day-time and sallies out at night to feed upon young plants which it bites off close to the ground.

Green notices that a single caterpillar will sometimes cut off as many as twelve young tea plants in one night, the severed stems being left lying about where they fall. It will thus be seen that the insect is capable of doing a good deal of damage.

Like other "cut worms" the caterpillar of *Agrotis suffusa*, when full grown, transforms into a chrysalis in the ground. From this chrysalis the moth afterwards emerges ready to mate and lays its eggs. The insect has been very carefully studied in America by Dr. C. V. Riley, United States Entomologist, who writes in one of his reports :—

"The eggs are laid in small batches, and often in two or three layers, covered sparsely with long scales from the abdomen of the female moth. They are pale-fulvous in colour, and nearly spherical in shape, the base being somewhat flattened. The polar ribs are not very distinct, and the crown is small. These eggs we have found laid on peach and sycamore leaves, upon which the larvæ do not feed. The larva in the first stage is also a semi-looper, the front prolegs being atrophied. The species is parasitized by Tachinidæ, which we have often bred from it."

In Behar opium fields the caterpillar has been reported as chiefly prevalent between November and March, the moth being common from the beginning of February until the beginning of March. A caterpillar, forwarded to the Indian Museum in May 1889 from Kurseong, transformed into a pupa on 17th May and emerged as a moth on 28th May. A moth again emerged in one of the Museum rearing-cages

in March 1890 from caterpillars forwarded from Oudh the same year. The Museum also possesses a moth from Jessore dated September. It may be concluded that in Northern India the insect goes through several generations in the course of the year. The precise habits in this respect, however, have yet to be observed in connection with tea.

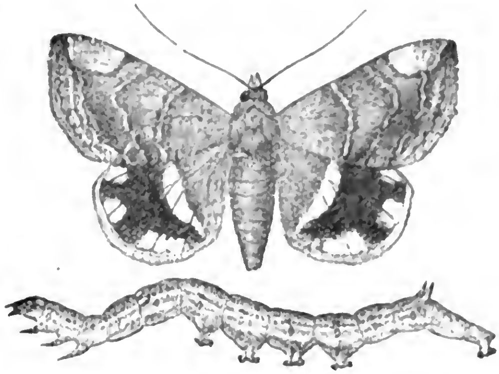
Digging the caterpillars out by hand or flooding them out of their burrows with water and then collecting them seem to be the most satisfactory methods of dealing with the pest.

According to Scott, who observed the insect in poppy-fields in Behar between the years 1874 and 1878, the cultivator goes round his poppy-plot in the morning, armed with a spade, with which he digs out the caterpillar wherever he sees the protruding leaves and stalks which mark the creature's burrow. Irrigation also is employed to bring the caterpillars to the surface, where they are fed upon by crows, mynas, starlings, cattle egrets and other birds, though these creatures are not sufficient by themselves to keep down the number of the insect. Scott adds that the pest can easily be checked by dusting the plants over a few times in the evenings with a mixture of quicklime and ashes, but he notices that the cultivators generally do not resort to this method.

Achæa melicerte, Drury. The caterpillar of this moth was reported from Dehra Dun in August 1892 as doing some damage to tea. It first appeared in the early part of the rainy season on the tallow tree (*Sapium sebiferum*), and seems only to have attacked the tea plant to save itself from starvation after all the leaves on the tallow trees had been devoured.

The species has been sent to the Indian Museum on numerous occasions as attacking a variety of crops in India, and as it has also been recorded as occurring in the Malay Archipelago and in Australia, its range must be extensive. Its principal food plant in India appears to be castor oil, which it often completely defoliates. It is said to pupate in the leaf, and the fact that caterpillars have reached the Indian Museum in such different seasons as January, July, August, and September, makes it likely that a number of generations are gone through in the course of the year. In the rainy season in Dehra Dun

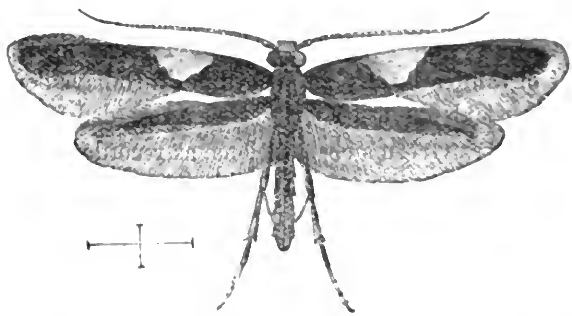
the caterpillar stage was said to have occupied from fifteen to twenty days, while about ten days were spent in the pupal stage.



The figure shows the moth and caterpillar, both natural size.

MICROLEPIDOPTERA.

Gracilaria theivora, Wlsm. This species was originally described by Lord Walsingham in the pages of *Indian Museum Notes* from specimens furnished to the Indian Museum by Mr. E. E. Green, who reared them from caterpillars which he found mining the leaves of the tea plant in Ceylon.



The figure, which is after Walsingham, shows the moth much enlarged. The natural size is indicated by hair lines. The insect is not known to do any appreciable damage in Ceylon, and has not yet been recorded from India.

The following summary of its habits, as observed by Mr. Green, is reproduced from *Indian Museum Notes*, Vol. II, page 50 :—

"The egg is laid on the underside of a young leaf, generally on a young bush. On the hatching of the egg, the young caterpillar mines the leaf, the mine being visible on the underside only and terminating in a small pocket formed by the folding over of the edge of the leaf. Here the caterpillar sheds its skin, and, this done, it proceeds to roll

the leaf together, so as to form a shelter in which it lives for the remainder of its larval life, feeding upon the substance of the leaf. When full fed, it is about three-eighths of an inch in length, and yellowish or greenish in colour, with a few short bristles scattered over its body. The chrysalis is formed in a flat silken cocoon on the leaf, the pupal stage lasting about two weeks. The caterpillar is attacked by minute Ichneumonidæ, besides being often drowned in wet weather by the water that accumulates in the rolled-up leaf."

Pandemis (? Capua) menciana, Walker (=*Cacœcia sp.*, Green). The caterpillar of this minute moth has been recorded by Green as doing a good deal of damage in Ceylon tea gardens. It has not yet been authoritatively recorded from India, but Bamber notices the presence of an insect which may perhaps belong to the same species.

According to Green's observations, as published in the *Ceylon Independent,* the caterpillar, which is a yellowish creature, when full grown about three quarters of an inch in length, feeds upon the young leaves. It twists up the leaves and spins them together with a silken web, thus rendering the shoots unsuitable for tea-making. When full grown, the caterpillar transforms into a chrysalis in a silken shelter which it spins for itself between two leaves. From the chrysalis emerges a minute brownish moth with the bell-shaped wings characteristic of the group Tortrices.

DIPTERA.

Oscinis theæ, Bigot, MS.—(=*Agromyza* (?) *sp.*, Green). This minute two-winged fly was discovered by Mr. E. E. Green, who traced it through its various stages of development in Ceylon, where its larva mines the leaf of the tea bush. It is not known to have done any appreciable damage in Ceylon and has not yet been recorded from India.

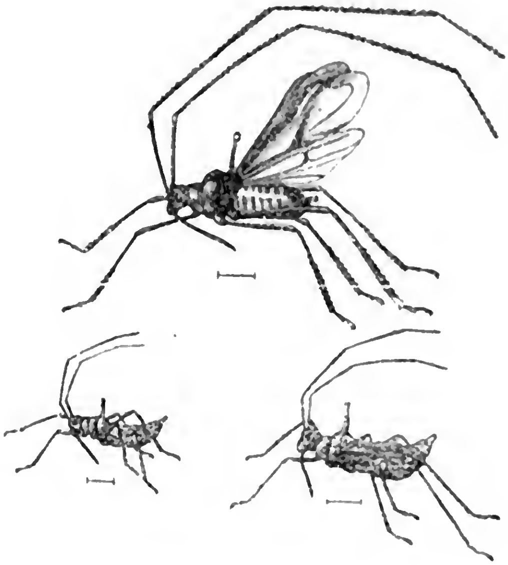
According to Mr. Green's observations, as recorded in the pages of the *Ceylon Independent,* the egg is laid upon the leaf. The larva, a minute yellowish maggot, burrows into the tissue of the leaf, leaving a sinuous tunnel easily visible from the exterior. When full grown, it pupates at the end of its tunnel, and emerges after a few days in the form of the adult fly. Mr. Green notices that the insect is subject to the attack of a minute hymenopterous parasite.

RHYNCHOTA.

Capsidæ.

Helopeltis theivora, Waterhouse—(=*H. theiovora,* Moore, as quoted by Wood-Mason). This insect does a great deal of damgae to tea. It chiefly attacks the tender leaves which are the ones used in tea-making, and as it affects wide areas, it is a formidable enemy to the tea trade. When full grown, it has much superficial resemblance to the

mosquito, and is hence generally known as "Mosquito blight." It may be distinguished at a glance by its knobbed scutellar spine which has been appropriately compared to a minute drumstick sticking out from the middle of its back.



The figures, which are taken from specimens in the Indian Museum collection from Assam, show the larva in two stages of development, also the winged form, all much enlarged. The natural size in each case is indicated by hair lines.

Attention was first directed to the insect by Mr. S. E. Peal, who published a valuable paper upon it in the Journal of the Agricultural and Horticultural Society of India (Vol. IV, 1873), with excellent figures, illustrating both the various stages of the insect after leaving the egg, and also the damage done by it to the tea bush. The method of oviposition was first described by the late Mr. J. Wood-Mason, whose report appeared in 1884. Further light upon the habits of the insect is afforded by some valuable communication to *Indian Museum Notes* from Messrs. Harcourt and Dudgeon; while for information relating to the practical side of the question, the writer is also indebted to a review of the genus Helopeltis by the late Mr. E. T. Atkinson.

The nature of the damage.

The insect injures the tea bush by sucking up the juice with its proboscis, which it inserts into tissue of the leaf much in the way that the mosquito sucks blood. The following extract from Peal's paper, as quoted in

Wood-Mason's report, gives an excellent account of the nature of the damage in Assam :—

"The general view of the tea is that the shoots are all brown, withered, and in fact dead, and the tea presents a generally brown look, instead of the bright healthy green that is usual.

"On examining a tree so affected, if the blight has only recently affected it, the appearance is very different from that of a tree which has suffered some time. In the former case, the general growth and the look is normal, but the youngest shoots and tips are more or less spotted with brown, the size of the spots varying with the age of the insect. If the bug is very young, the punctures are close and minute, and the discolorations coalescent; but if it is full grown, the spots are larger, say an eighth of an inch in diameter. Again, if the punctures are recent, the colour is pale brown and darkest at the edges; but if one or two or more days old, the spots are dark brown verging on black, the entire leaf curling up and withering completely if they are close.

"In the case of a tree that has suffered some time and severely, the symptoms are often less visible at first glance; the dead leaves have mostly fallen off, and the minute shoots at the leaf-axils alone show the damage, and all are dry and dead ; there is less dead leaf showing, and in its place we find dead 'tips' everywhere.

"A more careful study will often show a still more unpleasant fact—*i.e.*, that ere it ceased entirely to shoot out, the tree had made many efforts to grow, all of which had been rendered abortive; and a branch that has not yielded one single leaf or tip will present all the appearance of having been very severely and persistently plucked.

"On the tips of the young vigorous shoot being punctured, it has died as certainly as if nipped off, and the eyes below in the leaf-axils shoot out vigorously; and ere the bug can do serious damage, one or two shoots have attained some size and carry several leaves; but as the insects increase in size, these tips again are attacked and other shoots start from other eyes, though attaining a less vigorous growth, and in a short time we have a regular 'broom,' where not one leaf or tip has been taken by us, but has been killed off or sucked dry by the bug alone: drawings of such I send herewith to illustrate. When this is the case, growth will have come to a complete standstill, as every shoot requires from (say) forty to fifty days to mature from an eye to be fit to pluck. We may say the trees are shut up for about two entire months at least; and it is specially unfortunate that this takes place usually about mid-season, and when we should be doing our very best. I do not state that the entire garden is thus affected at once, or we should soon see tea itself at a standstill, but that the particular patches and trees most blighted are so as before stated. It is difficult to tell what part will be attacked this year or next: all places seem pretty equally liable to blight, and, unless very bad indeed, it is seldom seen, as yet, over an entire garden at once; but that this will be the normal state eventually, I do not doubt. The recovery of the tree is slow, unless pruned, and then is about as bad as the disease, as far as our outturn of crop is concerned."

According to a summary of Harcourt's notes on mosquito blight in the Darjiling district, as given in *Indian Museum Notes*, Vol. II, p. 43, the blight does not ascend above an elevation of about 4,500 feet, and most of the damage is done in the Terai, tea planted on black sandy soil appearing to be particularly attacked. Gardens are often affected to the extent of closing the crop earlier than usual and considerably lessening the outturn.

The life-history of the insect.

Helopeltis theivora belongs to a group of insects which do not pass through an inactive pupal stage. According to Harcourt, the eggs are about

$\frac{1}{32}$ of an inch in length and very slender. When first laid, they are hard and white in colour, but they become red before hatching. The larva feeds like its parents upon the young tea-shoots, and Harcourt notices that it becomes full grown in about a week after emerging from the egg. Harcourt adds that it has the characteristic bug-like odour, and that the only animal he has noticed to attack it is a small spider. In his report referred to above, Wood-Mason describes the female as "provided with a serrated oviposition, of the shape and sharpness of a sabre, wherewith to pierce holes in the soft tissues of the plant for the reception of her eggs." He writes:—

"The female deposits her eggs singly in the substance of the tenderest shoots of the plant, in the *internodes* or portions of the stem between the pekoe and the two or three leaves succeeding from above downwards, and in the buds developed in the axiles of plucked leaves and in the parts thereabout . . . . the presence and position of each egg is from the first indicated on the exterior by two unequally long, glistening, white, bristle-like prolongations of the shell, and later by discoloration of the point pierced. . . . . The respiratory processes of the egg-shell so closely resemble the fine pubescence which clothes the surface of the shoots as to be quite indistinguished from it by the unaided eye, and, to eyes unaccustomed to zoological work, even with the aid of an ordinary lens. . . . . In order that the reader may form some idea of the number of the eggs, I may state that on one occasion I counted more than forty eggs in twelve shoots taken consecutively and at random from a plucker's basket, and that on another occasion I selected and plucked from one bush of a plot of tea, which was only moderately blighted, four shoots with one or more eggs in each. The females appear instinctively to avoid puncturing the shoots or the parts of the shoots in which they lay their eggs, for one can rarely find eggs on badly-injured shoots."

The method of oviposition has since been carefully observed by Dudgeon, who has worked independently in Darjiling. His results, as communicated to *Indian Museum Notes,* confirm in the main those quoted above from Wood-Mason, who worked in Assam, and show conclusively that little weight need be attached to the supposed discovery by less skilled observers of other methods of depositing the eggs.

The chief points which remain to be ascertained in connection with the life-history of the insect are the length of time passed in the various stages of development at different periods of the year, and the method of hybernation, also the extent to which plants other than tea are liable to harbour the insect.

In 1881, when Wood-Mason visited Assam, he found that the China variety of tea was alone attacked, the indigenous variety being untouched. He also reported that he had been unable to find the insect either upon the weeds of tea gardens or on the vegetation of uncleared and waste lands in the immediate vicinity. Dudgeon, again, has shown conclusively that an insect which attacks the shrub *Maesa indica* in Darjiling, is totally distinct from mosquito blight, though it is liable to be mistaken for the latter on account of the resemblance between

the marks left upon leaves by the two forms. Under these circumstances the reports which frequently appear of the finding of mosquito blight upon plants other than tea must be received with caution. It is worthy of note, however, that a species of *Helopeltis* so nearly allied to *Helopeltis theivora* as to have been considered, by so competent an observer as the late Mr. E. T. Atkinson, to be but a variety of this species, were forwarded to the Indian Museum in January 1888 from Munghu, Sikkim, where they had been found on cinchona. Again, the species *Helopeltis antonii*, Sign., which Wood-Mason notices is so closely allied to the Assam form as to have been considered by no less an authority than the late Professor Westwood to be only a variety of it, has been reported by Dr. Trimen as having "caused much alarm by its depredations on cacao and cinchona plantations" in Ceylon.[1] Under these circumstances the subject would seem to require further investigation, as it has an important bearing upon the question, which has not yet been satisfactorily settled, of what becomes of the insect when off the tea.

Remedies.

Owing to finding the eggs of the insect on the young shoots, Wood-Mason suggested the vigorous and unremitting plucking of the blighted portions of bushes as likely to mitigate the evil. This treatment would no doubt tend to be beneficial, but cannot be looked upon as complete in itself, for Dudgeon has since shown that the eggs are largely to be found upon the portion of the green shoot which is passed over by the leaf-pluckers as too hard for manufacture into tea.

The following account of what was actually done upon a tea garden in Dibrugarh is quoted from a report by the Manager, published, without date, as an appendix to Atkinson's paper in *Indian Museum Notes*, Vol. I, page 185 :—

"Now to reply to your inquiries about what we did to get rid of the 'Mosquitoes.' To begin with, before we stopped plucking last year, and while the blight was at its worst (about September and October), I started cutting down a 'belt' of jungle 80 yards wide all round the edge of the garden ; this 'belt' was completed about the same time as the pruning of the garden was finished (the end of February this was): well, then I commenced lighting fires all over the place ; in the tea the prunings were being reduced to ashes as rapidly as the cut-down jungle in the belt was being burnt up; by the middle of March I finished all the burning I wanted to do, and then every soul was put on to hoe round the bushes, *take away all stale earth from near the stumps of the plants, and fill in fresh earth.* The pruning I went in for last cold weather was most severe : the whole of the garden nearly was cut down to within eight inches of the ground ; *all* knotty and gnarled wood was removed, and nothing but straight wood left. During the pruning, immediately following up the pruners were gangs of women and children armed with small knives whose only work was to rid the *bushes of every leaf and small twig.* To protect the plants from the flames (while the prunings were being

[1] *Vide Nature*, Vol. XXX, p. 634 (1884).

burnt) a drain fifteen inches deep by a foot wide was made in every alternate row of tea, and into this the pruning *leaves, &c.*, from round about were carefully brushed before being set alight to.

"Up to date not a trace of the blight is to be seen; this time last year about 100 acres (or more) were completely ruined; the tea is looking as healthy and nice, and growth is as vigorous as though the plants had never been blighted. So successful have we been so far in combating this destructive pest, that I am convinced now we will not be troubled with it *at all* this season, and that we will make our 8 to 8½ maunds an acre against a miserable 4 maunds an acre last season!

"The theory of letting tea run has been tried without the slightest signs of doing any good, for the simple reason the bushes *can't* and *won't* run! Bushes that I left alone during the three months (middle of April to middle of July) were, if anything, smaller at end of this period than at commencement of it, because not a vestige of growth had been made during the whole of this time, and the long healthy shoots (chiefly in the very centre, therefore the tallest part of the bush) died gradually down to the parent stem. I have measured some of these dead shoots occasionally and have found them in some cases to be over 18" long.

"The shoots that I have found to so die down have always been of this year's growth, *viz.*, those shooting out from just below last cold-weather pruning.

"Now, as blighted patches here have been found to have a large number of the young of the bug (which, by the bye, are in appearance like red ants, with two feelers apiece, and are wingless) in all stages of development (from the size of a pin's point to almost a full-grown bug) on nearly every bush, and as these young live right away inside the bushes and feed on only the 'minute shoots at the leaf-axiles,' the theory of pruning is to give the bush pruned a severe check and so stop for a time the rising of sap (and, of course, the production of the 'minute shoots at leaf-axiles') in the hopes this brief period of the bushes' dormancy will be sufficient to kill the young bugs of starvation. Whether we have succeeded or not in destroying *any* young ones by starvation it would be difficult to say, but that pruning is doing good is quite certain. Three days ago I got 25 maunds of leaf off the piece of tea that was pruned (5 acres in June last) in July; previous to pruning, this bit of tea was *completely* 'shut up' for about 2½ months.

"Of course we know it is only right to cultivate and keep extra clean any tea that may be 'hanging fire' or doing at all badly; I reversed the order of things with a bit of about five acres of very badly blighted tea: I allowed it to go into 'howling jungle,' the bushes were out of sight for over a month; strange to say, when I hoed and cleaned it up, after a fortnight, I found the bushes quite recovered and with a very decent flush on them. The block of tea of which these five acres are a part presents a peculiar spectacle with its small piece of bright green healthy tea surrounded by dismal-looking acres and acres.

"Some weeks ago I tried sprinkling kerosine and water (¼ of k. to ¾ of w.) over a piece (about 2 acres) of tea: on two occasions the day the mixture was squirted I found a young dead mosquito, evidently killed by the oil having reached them."

For accounts of other methods of dealing with the insects, reference should be made to Bamber's Hand-book, pages 247 and 248.

Helopeltis antonii, Sign. This species was originally described from Ceylon, where it was afterwards complained of as attacking both cacao and cinchona. It has since been referred to as attacking tea in Ceylon. It remains to be ascertained, however, to what extent the Helopeltis which is found upon Ceylon tea bushes is distinct from the insect referred to above under the name of *Helopeltis theivora.*

JASSIDÆ.

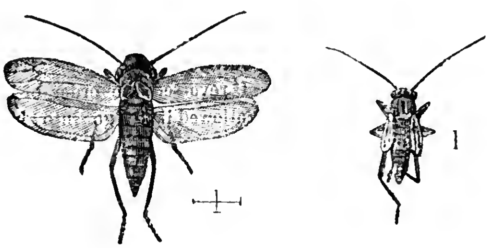
Chlorita flavescens, Fabr. (Green fly blight). A large amount of damage from this insect was reported in 1891 from tea gardens, especially in Cachar and in the Upper Assam Valley. Specimens reached the Indian Museum in the latter part of May from Assam, in June from Darjiling, and in July from Cachar.

In the case of the Upper Assam Valley, the insect is said to have appeared in the early part of the season and to have lasted on until June.

In no case do its habits seem to have been observed with any minuteness. It was generally supposed in the tea districts, however, to be responsible for the injury caused to the tea bushes, and as this was of a kind that it would be quite capable of inflicting, the probabilities are that it was rightly accused.

Both in life-history and method of feeding it is probably somewhat similar to *Helopeltis theivora,* though its eggs are more likely to be affixed to the leaf than buried in the tissue of the shoot. It may be noticed that the specimens forwarded to the Indian Museum in June from Cachar comprised both larvæ and adults.

The species is said to be fairly common in Europe and has also been recorded from Algeria, Brazil, and Siberia. It must necessarily, therefore, be able to subsist upon other plants besides tea.



The figure, which is taken from specimens in the Indian Museum collection from Cachar, shows the wingless larva when nearly full grown, also the winged adult. The figures are much enlarged, but the natural size of each form is indicated by hair lines, so no confusion need arise on this account.

According to a report dated 19th June 1891, from a garden in Cachar, as quoted in *Indian Museum Notes,* the insect stops the growth of the young shoots and prevents their ever becoming fit for plucking. The effect of the pest was said to be deplorable. Over whole sections of the tea garden the plants were covered with leaf about an inch in

length, which never grew any bigger; and one case is cited where 199½ acres had been plucked, and had given considerably less leaf than had often been obtained from a patch of seventeen acres. The only treatment that was tried was extra hoeing in the hope of bringing vigour to the bushes. The Manager adds :—

"To bring the state of things before you in the most comprehensive manner, I have pressed some shoots and send them by to-day's post, together with a little bottle containing about 100 of the insects which do, *or are supposed to do*, the damage. They are so active and difficult to catch that it took a boy a day and a half to procure the specimens to send. . . . . . On one side of the sheet of paper, on which I have pasted the samples of shoots, you will find healthily-grown leaves, ... purposely chosen, rather under than over the average as regards size, so as not to create a false impression, or make the comparison too striking. On the opposite side of the sheet are thrippy shoots of all kinds, from the smallest to the largest, but also representing three leaves and the bud. Every one of these should have been as big or bigger than the healthy shoots, but I think the total weight of the sixteen former would not equal that of the three latter. A glance at the specimens will show you how impossible it is to make any outturn out of growth of this kind."

The shoots in question were forwarded to the Indian Museum through the courtesy of the Calcutta agents.

They are shown half size in the figure above. The sprig marked (*a*) is an ordinary healthy tea-shoot, while those marked (*b*) are shoots of the same age but suffering from the attack of the insect.

According to another report, also quoted in *Indian Museum Notes*, the experiment was tried upon one garden of placing open lamps about in the tea, in hopes of attracting the insects and enabling them to be destroyed. It was found, however, that whereas myriads of other insects

came to the lamps, the green fly remained undisturbed under the tea leaves.

In view of the fact that *Chlorita flavescens* is allied zoologically to a species which attacks mango blossom, and which from an experiment conducted in Saharunpore has been shown to be susceptible to an arsenical insect poison known to the trade as *London purple*, the writer of this report suggested in the pages of *Indian Museum Notes* that this preparation might be worth trying on tea bushes. It was pointed out that great care would be necessary in any application of *London purple* to tea on account of the poisonous nature of the substance; though in cases where a garden had been shut up by the blight there would be no danger in the experiment, provided no plucking at all were done until after a new flush had appeared and the bushes had been well washed by rain. Experiments were afterwards made with this and other insecticides by Mr. M. K. Bamber, who has published an interesting account of the result in his work on the *Chemistry and Agriculture of Tea*, pages 250 and 251. The matter would seem to be worthy of further investigation, though the results so far obtained have not been altogether promising.

FULGORIDÆ.

? Phromnia marginella, Oliv. Homopterous larvæ insufficient for precise determination, but thought to belong to this species, were forwarded to the Indian Museum in February 1890 from a tea garden in the Assam Dooars.

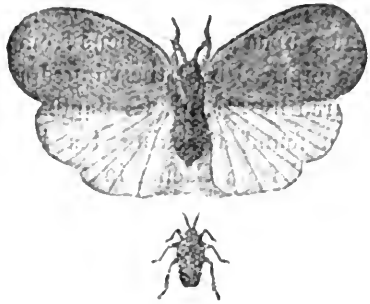
Very similar larvæ were sent to the Museum in October 1890 from a tea garden in the Mungledye District, Assam, with the information that they were feeding on the bushes and retarding the flushes, the whole garden being badly attacked.

Unfortunately the specimens from Mungledye cannot now be found. In recording the matter in *Indian Museum Notes* at the time, the writer of this note referred the insect to the species *Flata conspersa*, Walker, which is somewhat allied to *Phromnia marginella*, Oliv. Since then the Indian Museum has acquired undoubted specimens of the larvæ of *Phromnia marginella*, and comparison of these with the specimens from the Dooars has not disclosed any distinction of specific importance. As, therefore, both sets of specimens from tea in Northern India are likely to belong to the same species, they may conveniently be treated together under the heading of *Phromnia marginella*, for they are both undoubtedly related to this species, though the specific identity has not been made out absolutely in either case.

The most striking feature connected with the larva of *Phromnia marginella* is the dense white fluffy secretion with which the body is

covered. This gives bushes where the insect clusters a somewhat characteristic appearance which has been noticed by more than one observer.

The insect is a common one throughout Northern India. It has been reported as feeding upon *Elæodendron roxburghii* in the Central Provinces, and is likely to have several other food plants besides tea.



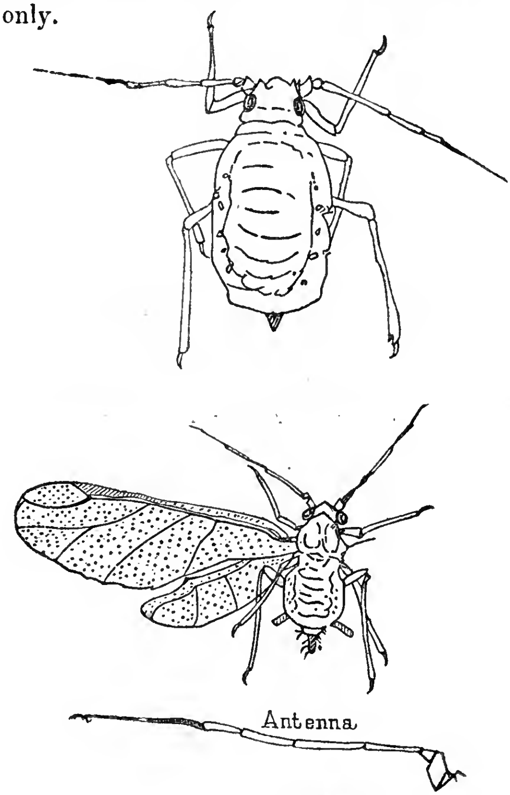
The figure shows the imago and half-grown larvæ, both natural size, of *Phromnia marginella;* the larva divested of its flocculent covering.

The habits of *Phromnia marginella* were carefully observed by the late Captain Thomas Hutton, who published a paper upon the subject in the Journal of the Asiatic Society of Bengal, Vol. XII, p. 898, (1843), in which he described the insect under the name of *Flata limbata.* The following summary is reproduced from *Indian Museum Notes* :—

"The insect was found by Captain Hutton on the lower slopes of the Mussoorie Hills in the North-West Provinces, the sugary secretion being only obtainable throughout the dry weather from January to June, as it gets washed away by the first heavy rain that falls upon it. According to Captain Hutton, the eggs hatch in December, and the larvæ cluster like sheep upon the food plant. They feed by sucking up the juices of the leaves, and moult several times, gradually increasing in size until the setting in of the rainy season in June, when winged imagos begin to emerge. In the imago the front wings are grass-green, with interior margins red; the posterior wings are milk-white, the body is greenish, and the abdomen is generally covered up with white flocculent matter similar to what is found upon the larvæ. The eggs are laid in considerable numbers in the bark of the twigs, a slight swelling of the wood often taking place where the eggs have been laid. The imagos move but little from the food plant and often live on until after their eggs have hatched in the cold weather. The larvæ, and to a less extent the imagos, are covered with masses of white flocculent matter, which is thought to be secreted by small glands distributed over the abdomen, and opening by minute pores in the integument. The sugary matter is said to be excreted in a liquid state by the larvæ, and drops on to the leaves, where it hardens. Little is known of the method of its origin, but it is likely to be secreted by the large gland-like organs which are situated on either side at the extremity of the abdomen in the larvæ."

Aphidæ.

Ceylonia theæcola, Buckton (**Aphis sp.,** Green). This species was originally described from specimens forwarded to the Indian Museum by Mr. E. E. Green, who found both the winged and wingless form in large numbers on the succulent shoots of young tea plants in Ceylon. Representatives of what is undoubtedly the same species have since been sent to the Indian Museum upon two occasions from Indian tea gardens. The first to be received comprised both the winged and wingless forms, and were forwarded in March by Mr. M. K. Bamber, who has since noted that the species has been found attacking tea in most districts; the second to be received arrived from Cachar in August and comprised the wingless form only.



Ceylonia Theæcola

The wood-cut, which is taken from Buckton's figures in *Indian Museum Notes*, shows the wingless and the winged form both enormously enlarged, also the antenna of the latter still further magnified.

The insect itself is a tiny blackish creature, the body of the winged form being only about one twenty-fifth of an inch in length.

Like other Aphidæ, *Ceylonia theæcola* feeds by sucking up the juices of the plant through its slender proboscis. Its effect on the young leaves it attacks is said to be to cause the edges to curl up and become distorted.

The life-history of the insect has not as yet been completely traced, but Mr. Green has observed that both the winged and wingless forms reproduce themselves parthenogenetically, the young settling down beside the mother and becoming full grown in about ten days after they are born. As in the case of numerous other species of Aphidæ, ants are attracted by the honey-dew secreted by the glands connected with the two large tubercles, shown in the figure of the winged form, on either side of the abdomen, and are to be found in constant attendance.

Mr. Green notes that in Ceylon the Aphid is not only liable to be devoured by the larvæ of Syrphidæ, Hemerobidæ, and Coccinellidæ, but is parasitized by a minute hymenopterous insect, the combined effect of these enemies being so considerable that it is often completely kept in check by them.

As the result of his experiments Mr. Green considers that wood ashes, powdered sulphur, and dry carbolic powder are alike useless as applications for destroying the pest. On the other hand, washes, either of dilute kerosine emulsion or of phenyle, are effective. The proportions he recommends are one part of kerosine emulsion to eighty parts of water, or one part of phenyle to two hundred and forty of water; the wash to be applied in the evening or on a cloudy day, as hot sunshine, following its application, is apt to scorch the leaves; in the case of phenyle the application of the wash to be followed the next morning by a copious drenching with ordinary water.

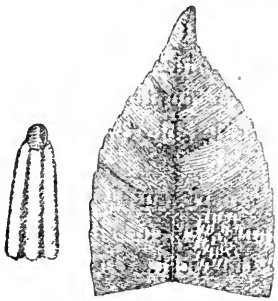
COCCIDÆ.

Chionaspis theæ, Maskell—(=*The tea bark louse,* Green). This insect was first observed in Ceylon by Green, who found that it was very generally prevalent upon tea, where it accounts for many "hide-bound" and unproductive bushes. It has since been sent to the Museum from tea both in the Kangra Valley and also in Cachar. In the Kangra Valley kerosine and soap emulsion is said to have been tried upon it with success, though the insect does not appear to have as yet caused very much damage.

The female is a little rounded flattened scale about a tenth of an inch across. It is to be found upon the branches of the older bushes, and is so much like the bark on which it rests as to be unnoticeable except on very close inspection. In its earlier stages, the male is a tiny

little white fluted scale which is often to be seen in colonies on the leaf, where it is comparatively conspicuous ; it eventually transforms into a minute creature which Green describes as bright red in colour with four prominent black eyes.

As in the case of other species of the same family, the eggs are laid beneath the female insect, which never quits the spot on which it first settles down. The larvæ are minute six-legged creatures which crawl actively about after leaving the eggs. They eventually settle down and insert a long proboscis into the tissues of the plant. Through this proboscis they gradually absorb the nutrient juices on which they feed, and in this way they weaken the plant. The female insect continues to absorb the juices of the plant throughout the whole of her existence, but the male takes no food after it becomes winged.



The figure shows a colony of male scales on a leaf natural size, also an individual scale enormously enlarged to show the characteristic ridges with which it is covered.

Male scales have been forwarded to the Museum in December from Cachar and in February from the Kangra Valley, so the winged male is likely to emerge in the early part of the year. Green has noticed that the live female scale is sometimes covered with lichens which must have taken some time to grow, so the life of the insect in this stage is likely to be prolonged. The dates of emergence, also the periods passed at different times of the year in the various stages of development, have yet to be ascertained.

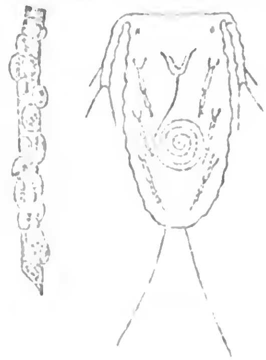
In all scale insects the question of dispersion is an important one, for owing to the adult female being stationary, it is only the newly-hatched larvæ which are able to travel from bush to bush, and thus spread the evil. It is important, therefore, to ascertain at what period of the year the larvæ emerge and the extent to which they are liable to be carried by the wind.

Under ordinary circumstances insects of this kind spread slowly ; it is therefore most important to watch them carefully, for, whereas it may

be easy enough to keep them in check with kerosine emulsion or other treatment when only a few bushes are attacked, the case becomes very different when large areas have been allowed to become affected.

The hydrocyanic gas treatment, described on page 65 of this report, is especially applicable to this species.

Aspidiotus flavescens, Green—(=*A. theæ,* Maskell). This insect was originally described by Green in the pages of the *Ceylon Independent.* It has since been reported both from Assam and the Kangra Valley. According to Green's observations it attacks young plants of from one to two years' growth, and often injures them to such an extent as to make it necessary to replace them with fresh plants.



The figure, which is after Maskell, shows a piece of tea twig, natural size, covered with female scales, which are yellowish in colour and conspicuous. To the right is an enormously enlarged diagram of the newly-hatched larva to show its legs and antennæ, also the long coiled proboscis which it eventually inserts into the tissues of the plant.

The insect is likely to be very similar to the preceding in its development, but its precise life-history has yet to be traced.

Aspidiotus transparens, Green. This insect was originally discovered upon tea bushes in Ceylon by Mr. E. F. Green. A few isolated scales of what is thought to be the same species have since been found upon leaves forwarded to the Indian Museum in January 1894, from a tea garden in Jalpaiguri. Neither in Ceylon nor in India, however, has the insect yet been reported as occasioning any appreciable injury.

As seen upon the tea leaf, the scales appear as flattened semi-transparent, yellowish discs, from one to two millimetres in diameter.

The life-history of the insect has yet to be traced through the various stages of development.

Lecanium coffeæ, Nietner. This insect, which is usually accompanied by a black fungus which grows upon its secretion, was described

many years ago by Nietner as attacking coffee in Ceylon. It has since been found upon tea in Ceylon by Green, who has published an interesting account of his observations in the *Ceylon Independent.*

It has not yet been noticed upon tea in India, but has been recorded as attacking coffee in the southern portion of the Peninsula. The following account of the insect is taken from Nietner's work on the *Coffee Tree and its Enemies.*

"*Lecanium coffeæ* (Brown or scaly bug[1]). Male: Head transversely ovate-rotundate narrowed, and square in front; eyes large, black; ocelli 2, small, lateral; antennæ 9-jointed, 2nd joint smallest, 3rd longest, thence decreasing to the tip; mouth as in the male of the white bug. Thorax ample, cordiform, narrowed in front; wings 2, hyaline, 2-nerved, subcostal nerve dark pink, not folded straight down the back when at rest, but half spread out. Scutellum as in white bug. Abdomen triangular-sub-cylindrical of shrivelled appearance, with 2 lateral points, 1 central appendage, and 2 long, thin, white filaments at the extremity. The insect is still more delicate than the male Pseudococcus, of clear, light pinkish-brown colour, slightly hairy; very pretty.

"Female: Apterous, tortoise-like, yellowish, marbled with grey or light brown, sub-oval, more or less semi-globose according to age, back with one elevated longitudinal and 2 transverse costæ, uneven; split behind, at the extremity of a split bifid anal flab of brown colour; eyes marginal, black; antennæ 7-jointed, 3rd joint longest; proboscis with 1 long sucking bristle. The old individuals are light brown with a dark margin, smooth, semi-globose, fixed to the branch.

"Larvæ of female with 2 anal filaments which are lost in after-life. The larvæ and pupæ of both sexes are active, with the exception of the male pupa, which is plentiful on the underside of the leaves, where the long, narrow, oval shell under which it rests is easily discovered. This shell is transparent, and composed of 9 plates, 3 central and 3 on either side. I have occasionally found the entire underside of leaves covered with nothing but male pupæ, all dead. This species of bug affects elevated (above 3,000 feet), cold, damp, close localities, where it is found in all stages of development all the year round, the propagation being, as in the white bug, continuous. As in the latter species, the males seem to be more abundant about June and January than at any other season. The eggs, which are oval and of pinkish colour, are not actually brought forth by the female, but when they are matured the parent insect dies, the whole interior forming one mass of eggs protected by the shell.

"This kind of bug is closely allied to the lac insect (*Coccus lacca*, K.) of India.

"The brown bug is much infested by parasites, amongst which the following are the most common:—

Scutellista cyanea,
Encyrtus Nietneri,
,, *paradisicus,*
Cephaleta purpureiventris.
,, *brunneiventris.*
,, *fusciventris.*
Cirrhospilus coccivorus.
Marietta leopardina.

[1] "This insect is generally called 'black bug,' but the above is a more correct name, it being of brown colour, and only the fungus found in its company, black."

"These are all Hymenoptera of the most minute description, presenting under the microscope the most elegant forms, and for the most part the most brilliant metallic colours. The Marietta, for instance, is shotted or ocellated all over black and white, like a leopard. They can easily be obtained by putting a bugged branch, cut in convenient lengths, into a bottle, when after some time the little wasps will be found flying about inside, having made their escape from the bugs. The mother parasite lays her eggs amongst the bugs ; when hatched, the young larvæ find their way easily to the soft underside of the bugs, where they attach themselves like leeches, and, protected and fed by the body of the bug, remain until they reach the perfect state. A bug thus attacked produces of course no eggs, and, instead of the young bugs, in course of time there escape these little wasps. The shells of the old bugs are frequently found with one or two holes ; it is from those that the parasites have escaped. I have seen as many as six larvæ (belonging to different species of Hymenoptera) attached to one single bug. These larvæ can easily be seen on turning up some old bugs with the point of a penknife ; they are little white or yellowish eyeless and footless maggots, some of which can leap to a considerable distance by doubling themselves up and spasmodically extending themselves again to their full length."

THYSANOPTERA.

Thrips sp. ? A representative of this group of minute insects has been recorded by Green as feeding upon the leaves of the tea plant in Ceylon, where it causes unsightly patches, especially on the backs of the leaves. As in other species of the family Thripidæ, the eggs are said to be laid on the leaf, where the larvæ and adults are also to be found. The adult may be recognised by the curious narrow hair-fringed wings which are characteristic of this family of insects. Green notices that the same species also attacks rose bushes and fuchsias in Ceylon. He found it to be subject to the attack of a minute hymenopterous parasite.

ORTHOPTERA.

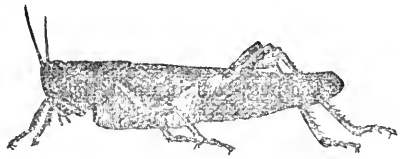
ACRIDIDÆ.

Between the years 1889 and 1891 almost all the tea districts in India were visited by stray flights of the locust *Acridium peregrinum*, Oliv., from the deserts of the Punjab and Rajputana. The insect often settled in countless numbers upon the tea bushes, but seems to have disliked the flavour of the tea leaf, and to have occasioned no perceptible damage. It is unnecessary, therefore, to do more than refer to it amongst the various insects which attack the tea plant in India.

The same does not hold of other species of Acrididæ which are usually spoken of as " locusts," though they frequently differ in important points from the migratory forms.

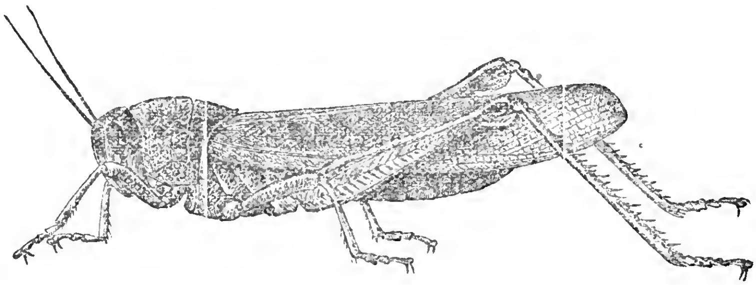
In February 1892 injury of the kind to young tea plants was

reported from a garden in the Western Dooars. Of the insects forwarded to the agents in Calcutta, some were identical with specimens in the Museum collection determined by Dr. Henri de Saussure as his *Catantops indicus*, which is figured below natural size, while others were



a variety of the same species characterised by the absence of striped markings on the posterior femora.

Two specimens of the species *Acridium flavicorne*, Fabr., as determined in the Indian Museum collection, were afterwards forwarded as associated with the insect first reported.



A small specimen of the male of *Acridium flavicorne*, Fabr., from the Museum collection, is figured above, natural size.

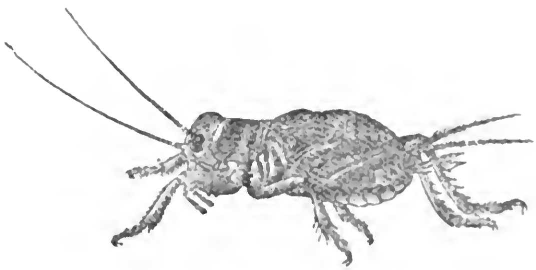
In the end of February the Manager wrote that he had been to a great extent successful in destroying the insects, and that he had not heard of their appearing on any of the neighbouring gardens. The method adopted was hand-collecting by coolies, who were paid two annas per hundred insects. Up to the date of his letter the Manager estimated that he had destroyed 31,770 insects in this way, with the result that they were getting so much scarcer that, at the time he wrote, the coolies were only bringing in about 25 per cent. of the daily number they had been able to obtain when hand-collecting was first started.

Acrididæ of this kind are likely to lay their eggs in the ground. The larvæ are active grasshoppers, which differ from the adult chiefly in being smaller in size and wingless. They are active throughout their entire existence, and devour the leaves of plants in large quantities. The

individual habits of the two species referred to above have yet to be observed in India.

GRYLLIDÆ.

Damage of sufficient extent in tea nurseries to make it occasionally worth while to keep children employed collecting the insects by hand has been noticed as caused by crickets in Assam. The only occasion on which representatives of the insect concerned have been sent to the Indian Museum was in July 1893, when some larvæ of the species *Brachytrypes achatinus*, Stoll., as determined in the Museum collection, were forwarded from Jorhat.



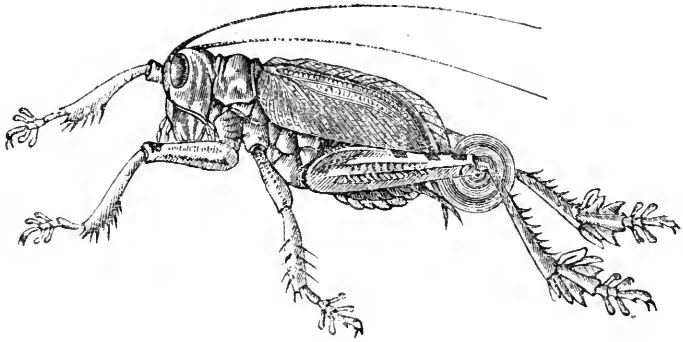
The figure shows the insect natural size. Like others of the same group, it transforms, when mature, into a creature very similar in appearance, but differing in the possession of large membraneous wings, which are neatly folded on the back so as not to interfere with burrowing. The eggs are likely to be laid in the ground, but this and other points in connection with its life-history have yet to be traced by actual observation.

According to information furnished from the garden in Jorhat where the specimens were procured, the insect cuts the young tea plants off level with the ground at night; in the day-time it conceals itself in a burrow from nine to eighteen inches deep which it constructs in the ground; it is specially abundant on sandy soil, and may be recognised by the shrill piping which it makes in the evening when it sits in the mouth of its burrow.

The species *Brachytrypes achatinus*, Stoll., has previously been sent to the Museum as causing serious damage to jute and rice crops in Bengal; tea is therefore likely to be only one of a number of plants on which it feeds.

Another common species of Gryllidæ also likely to attack young tea plants, though it has not actually been sent to the Indian Museum in

this connection, is *Schizodactylus monstruosus,* Drury, the adult male of which is shown below, natural size.



This species can be at once recognised by the curious structure of the tarsal joints, and also, in the adult, by its curious curled-up wings. It is known in the indigo districts as *bherwa,* and does a large amount of damage by cutting off indigo, tobacco, and other crop plants with its enormous shear-like jaws.

TERMITIDÆ.

White ants are sometimes very plentiful in Indian tea gardens, where they occasionally do a good deal of damage, especially to young and weakly plants. The identity of the species concerned has not yet been satisfactorily ascertained, and the life-histories of the various forms have still to be traced through the different seasons of the year.

The commonest species in Lower Bengal is *Termes taprobanes,* Walker, and this is likely to be the form whose large earthen nests are often to be found amongst mature tea bushes, where, however, they seem, as a general rule, not to do very much harm. A distinct and larger species has been described by Green from Ceylon, where he observed that it was liable to attack the stems of full-grown tea bushes to the extent of completely tunnelling out the contents.

The following, which is taken from a manual of zoology prepared by the writer of this report for the Forest Department of India, gives what are said to be the general habits of Termitidæ as observed in other parts of the world. The figures are from specimens of *Termes taprobanes* in the Museum collection.

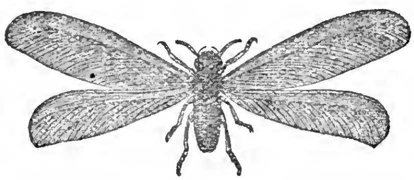
White ants live together in communities, which consist of the following four sets of individuals :—

(1) A female or queen (shown above, natural size), with enormously distended abdomen ; she is incapable of locomotion, and lays all the eggs of the community.

(2) Small ant-like neuters, which may be compared to the worker bees. They are of two kinds, *viz.*, individuals with large heads and sharp mandibles to defend the nest, and individuals with small heads to build the passages and nest, collect food, and do all the work of the community. The figure above shows the two forms of neuter, both somewhat enlarged, the natural size, in each case, indicated by a hair line.

(3) Wingless larvæ which develop into winged males and females. This form is shown below, to the left, enlarged, the natural size being indicated by a hair line.

(4) Winged males and females. The males and females fly out of the nest in clouds, generally after rain. Those of them that escape their numerous enemies are said to drop their wings and copulate. The female either finds her way back to the original nest or starts a fresh nest for herself. Her abdomen grows by distention of the membranes between the chitinous plates, until she becomes like a sausage, two or three inches long, with a minute head and thorax at one end (*vide* first figure). Queens in several stages of development may sometimes be found in a single nest. The figure above, to the right, shows a young queen shortly after dropping her wings and before the abdomen has grown very much. The figure is somewhat larger than life, the natural size being indicated by a hair line at the side. Below is a figure of one of the winged forms, natural size.



Various suggestions for dealing with white ants in tea gardens are given by Bamber in his work on the *Chemistry and Agriculture of Tea,* pages 254 and 255.

ACARINA (MITES).

Teranychus bioculatus, W. M. (Red spider). This mite, previously known to tea planters under the name of "red spider," was described by Mr. Wood-Mason in his *Report on the Tea Mite and Tea Bug of Assam, 1884.* It has since been identified by that careful observer Mr. E. E. Green [1] as belonging to the same species as the "red spider" of the coffee tree, described many years previously by Nietner[2] under the name *Acarus coffeæ.*

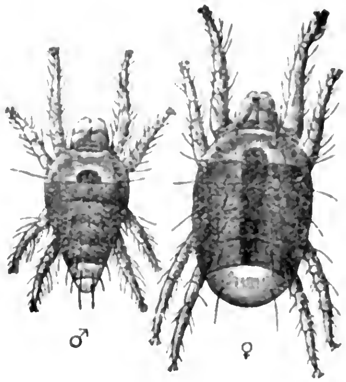
Unlike both "mosquito blight" and "green fly blight," the red spider of the tea plant chiefly confines its attack to the mature leaves. It is

[1] *Insect Pests of the Tea Plant, No. 7.*

[2] *Observations on the Natural History of the Enemies of the Coffee Tree in Ceylon.*

essentially a hot-weather pest, and almost completely disappears when the rains break, though colonies are subsequently to be found upon sheltered bushes.

In Ceylon, where red spider also attacks tea, Mr. E. E. Green has noticed that the tomato plant is likewise liable to suffer. The figures,



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which are after Wood-Mason, show the male and female mite both enormously enlarged. The male is considerably smaller than the female, the latter being described as about one twenty-fifth of an inch in length.

The following is taken from Wood-Mason's report :—

" The mite lives in societies on the upper surface of the full-grown leaves, beneath an exceedingly delicate web, which it spins for itself as a shelter. This web, ordinarily invisible to the naked eye, is often rendered visible by the deposition upon it of dew in minute globules, which give to the leaves, when bathed in the morning sun, an indescribably splendid appearance of being sprinkled over with minute diamonds. I believe that this web serves chiefly as a protection to the tiny arachnids from dew and light showers, for heavy rain, especially if long-continued, breaks up the sheltering webs, and thus leads to the disappearance, if not to the destruction, of the pest.

" The mites lay their eggs in hollows, close to the ribs of the leaves usually. The eggs are oblate spheroids, flatter at one pole, by which they are firmly and broadly attached to the leaves, than at the other, at which their transparent shell is suddenly drawn out into a long and tapering and slightly curled glossy process. They are red, like the mite itself, and at the close of segmentation present at their surface a beautiful reticulated pattern, due to the presence of a concentrated and dark-coloured layer of protoplasm around the nucleii of all the cells of the blastoderm. The young arachnids leave the egg as six-footed larvæ, which do not attach themselves as parasites to the bodies of insects and spiders, as do their distant relations the Trombidiidæ, nor undergo any of those strange changes which many other mites pass through in the course of their development, but attain to the adult condition by a simple change of skin that usually, though not perhaps invariably, is made on the same leaf as that on which they emerged as larvæ from the egg. The shells of the hatched eggs remain glued to the leaf for some time as microscopically small objects resembling porcelain saucers.

"Preparatory to the final moult the mites draw all their legs in under them, become perfectly motionless, and appear to change from red to white; but no change of colour actually occurs, the appearance of whiteness which the thin and colourless old skin presents being due to the access of air to the interval between it and the new.

"The male differs from the female not only in size but also remarkably in the form of the body. The former sex is the smaller, and in the shape of the body resembles a plover's egg, being broadly rounded at the anterior end and pointed posteriorly, while the latter resembles an egg which is similar and semi-circular in outline and nearly equal at both ends.

"The males are most solacious little creatures, and the very remarkable mode in which they couple with the female has frequently been witnessed by me under the microscope. After a brief courtship, which consists in actively and excitedly careering round and round the female for a few seconds, in caressing her with his sensitive feet, and in exciting her by repeated thrusts from his needle-shaped and protrusible mandibles, the male embraces the female by placing his two front pairs of legs upon the upper surface of the end of her body, then suddenly dives downwards and forwards beneath her body, retaining firm hold of her by means of the claws and suckers with which his legs are furnished, and finally extends and recurves the end of his soft and flexible body until his genital aperture, which is placed on the ventral surface just in front of the terminal anus, is opposite to that of the female, which occupies a similar position.

"The mite injures the tea plant by repeatedly puncturing the leaves and pumping out the liquid contents of the epidermis (? and parenchyma) through the punctures by the aid of the pharyngeal pump with which it, like all other arachnids, is provided. A freshly-punctured leaf exhibits a regular and pretty pattern of irregular star-shaped patches of light green worked upon a dark ground. The pale spots are caused by the mites, and in the centre of nearly every one of them two most minute punctures can only with difficulty be made out, even by the aid of a microscope. In order that the manner in which the punctures are made may be understood. it will be necessary briefly to describe the mouth-parts of the animal. These consist of (1) a conical rostrum or beak, the sides of which are embraced and partly formed by (2) a pair of short, stout and jointed palpi or feelers which end in a pair of pincers, and answer to the great claw-bearing feelers of the scorpion and to the first maxillæ of an insect; and of (3) a pair of jaws or mandibles, which do not enter into the composition of the beak above, and in front of which they lie, but between which and them, on the contrary, there exists a wide interval. The rostrum is not sterrated on the edges so as to resemble that of an ordinary tick, as it is in the European *T. telarius,* but on each side of the minute slit-like opening which constitutes the mouth, and is placed at its lower extremity, it bears two minute curved and probably movable spines. At the ends of the short fixed arms the pincers of the feelers open the ducts of the glands, which furnish the viscid secretion wherewith the animals spin their protective webs. The mandibles or jaws are a pair of long and delicate needle-shaped rods, which ordinarily lie retracted out of sight into their sheaths ready to be shot out with lightning rapidity. It is a remarkable fact that the sheaths, which appear to be none other than the basal joints of the mandibles, retain their primitive embryonic distinctness throughout life, and do not coalesce in adult life so as to form a single common sheath, as they are said to do in *T. telarius.* It is more probable that the leaves are punctured by these mandibular needles, and that the two little movable spines placed at the sides of the rostrum serve only to keep the sucker-shaped elevation around the mouth

closely applied to the wounded spots in order that the buccal pump may act as effectually as possible, than that the latter perform the double duty of lancets and retentive hooks.

"The Tea-Mite is an excessively minute animal, the female measuring only about one twenty-fifth of an inch, or about one millimetre, in length between the extremities of the outstretched anterior and posterior group of legs, and the male being about one-sixth smaller. The egg-shaped body is divided, except when inflated to its fullest extent by imbibed tea juices, by distinct grooves into six divisions in the female and into seven in the male; and each of these divisions, as to which it is exceedingly doubtful whether they represent true segments, bears two pairs of long and stiff and backwardly directed white hairs, forming four longitudinal series placed two on each outer third of the upper surface; the first segment, which has only one pair of hairs, and is moreover longer in the male than in the female, carries, in both sexes, two groups of two unequal eyes, forming two pairs, one of which, the anterior, is smaller than the other.

"To the naked eye the Tea-Mite appears as a dull blood-red speck, but under the microscope presents itself as a much brighter and more variously coloured object, its legs being of a pale flesh-colour adorned with a light crimson stripe, the front segment of the body bright crimson with a semi-circular mark in the middle of its hinder margin, concolorous and in contact with the deep blood-red of all the remaining segments in the female, which is dark blood-red from the front end of the second segment to the extremity of the body, but of the four following segments only in the male, which has the two terminal segments bright crimson, like the front of the body. The legs are sparingly clothed with long and colourless hairs, and they are all terminated on each side by one or two curved bristles and in the middle by a single hooked claw, on either side of which there spring from the apex of the terminal joint of every limb two delicate glassy threads with enlarged tips, forming long and thin-stalked suckers, by the aid of which the mites are enabled to retain their footing and to walk securely over the leaves, and the males to clasp the females firmly by the back during copulation. In crushed specimens which had been rendered transparent by reagents, a pair of highly refractive and spheroidal solid bodies having a faint concentric structure was always to be made out beneath the skin in front of and internal to the eyes, in a position, therefore, corresponding as closely as possible with that in which Claparède never failed to find in embryos, but only in embryos, of *T. telarius*, a pair of sacs each containing a pear-shaped solid body.

"I propose for the Tea-Mite, which would appear to be unknown to science, the name of *Tetranychus bioculatus* in allusion to its double (really two pairs of) eyes.

"The Tea-Mite, so far as I have been able to make out, usually first affects small patches consisting of a few bushes, whence it rapidly extends over the whole or a large part of a garden. It always seemed to me to consist of numerically larger and more active societies on the bushes of very old gardens, from which it never appeared to be entirely absent, as vigorous societies were to be obtained therefrom as often as I wanted fresh material for my observations.

"The view entertained by many planters that this pest is carried to gardens and distributed over them by insect agency does not receive the least support from my observations. Moreover, the analogy of the closely-allied European species, *T. telarius*, is wholly opposed to such a notion, which doubtless owes its origin to the Tea-Mite having been mistaken for some one of the numerous red or reddish-yellow Mites belonging to totally different groups, which do commonly occur parasitically on the outside of the bodies of the most diverse groups of insects—a kind of parasitism which is of such common occurrence that I have rarely if ever sorted the contents of a

bottle containing a mixed collection of terrestrial arthropods preserved in spirits without finding one or more individuals, or even species, of these parasitic arachnids, and the least observant amongst us must have repeatedly met with instances of it.

"When first attacked by the mite the leaves have the appearance described above; but as the punctures increase in number they gradually assume a dull, dirty coppery-reddish tinge, become dry and bent and cockled, and finally fall to the ground, leaving, in extreme cases, the stems and branches of the bushes bare. A badly-smitten garden may be recognised from a distance by its red colour."

The principal points in connection with the life-history of the mite which remain to be ascertained are the number of generations in the year and the length of time spent in its various stages of development.

The mite is only capable of slow locomotion, and therefore spreads in the first instance very gradually. From Green's observation of its presence upon sheltered bushes in the rainy season, it may be expected to be found to lie up in this manner until the time comes round for it to recommence operations upon the bushes generally.

In consequence of its frequent localisation in certain areas, red spider lends itself specially to destruction by artificial means and numerous experiments have been made to this end.[1]

Sulphur *versus* red spider.

The most promising agent for use against red spider appears to be sulphur in one form or another. The only method of applying it which seems as yet to have been adopted in Indian tea gardens upon any considerable scale is that of dusting flour of sulphur over the affected bushes. This is said to have been first tried in the Darjiling district, and has since been taken up elsewhere.

The following series of reports by Mr. G. F. Playfair, furnished through the courtesy of Messrs. Barry & Co., give a full and excellent account of the experience of a Cachar tea planter in the matter.[2]

14th March 1892.—"I am taking advantage of the present hot weather to apply the sulphur as advised by Mr. Christison, who makes a point of putting it on during times of bright sunshine. I find the quantity used is exactly one hundredweight to the acre, and cost of application R1-6. Up to date I have sulphured 60 acres, and will keep on as long as the sulphur lasts or the drought continues. I have given up my original intention of applying half now and the balance when red spider becomes active, as I find in places a good deal of blight is already visible, and I am hopeful that the sulphur will stamp it out before the insect has time to propagate. Some experiments with the mosquito itself tend to show that it dies if lightly dusted with the sulphur."

25th March 1892.—"Red spider began to show itself all over the early pruned sections, but I applied the sulphur as fast as I could, and wherever the application

[1] Amongst other preparations, decoctions of tomato leaves in water have been strongly recommended for spraying over affected bushes. The number of applications required, however, to rid a single bush in this way of the pest is so great as to render the treatment inapplicable for large areas. In view of what is known of the habits of the pest, it has been suggested as probable that spraying the same number of times with water alone would be almost equally effective.

[2] Most of these reports have appeared in *Indian Museum Notes*.

was made not a trace of spider remains. Altogether 138 acres have been sulphured with the five tons sent up. The sulphuring has been most carefully done, either a Babu or Mr. Burns being in constant attendance, and, as far as can be judged at this early stage, the experiment is likely to be a very remunerative one. Whether or not the spider will come back remains to be seen, but at the present moment I can guarantee there is not a single affected bush over the whole 138 acres."

13th April 1892.—"The drought still continues, only ·86 inch of rain having fallen in April, the total to date since the 1st January being 4·05 inches. Notwithstanding, Bundookmara is looking very well and would flush at one with rain. The great heat and dryness of the soil have brought on some red spider, but not much, as the early pruned sections were all sulphured, and the later pruned have not yet sufficient foliage to make red spider harmful. It is gratifying to observe that not a single plant over the sulphured area shows the slightest sign of red spider, and blight, which had appeared with the first growth, has also entirely disappeared. I believe that in dealing with the one disease we have also dealt with the other, and that the early part of the season will be free from blight."

18th April 1892.—"There have been no charges in connection with the sulphur—it having been brought up to the garden by my own boats. From the invoice and estimating for freight, I make out the five tons have cost approximately R900 and applied to the bushes about R8-4 per acre. A very small increase in yield will cover the expense, and I am hopeful, from the look of the sulphured sections, of proving to you that the money has been well spent. You must not expect to see any very startling increase in outturn in consequence of the sulphuring, as I have naturally treated those flats which are the poorest and most in want of encouragement; but if by doing away with spider, and possibly blight, I can in time bring these flats from poor to good, the gain will be great indeed. At the present moment I believe that the application of sulphur will result in an increase of a maund of tea per acre; it certainly will be so if blight is mitigated as well.

"I have written out extracts from my diary, giving you full particulars respecting the way the sulphur was applied, the state of the bushes before, and the immediate result after application. It will be interesting to compare this report with subsequent ones which I will send from time to time in the same form."

Abstract of diary.—"The treatment was begun on 7th March 1892 and completed on 21st of the same month. Sixty acres were treated at the rate of one hundredweight to the acre, which gave a very sufficient sprinkling, sixty-seven acres at the rate of two hundredweight to three acres, while eleven acres were treated with a mixture of one part of sulphur to two parts of sifted lime. The tea that was treated was of the 'China' variety. The bushes were rather below than above the medium size. They had not put out much growth owing to the drought. Red spider had appeared, and careful examination showed that it was present in many places. The application of the sulphur was made through *markin* cloth by simply shaking the bag over the bush. Where water was available the bushes were first splashed with water, but over a considerable area the application was made without previous watering. The sulphur adhered fairly well even on dry bushes, in spite of the high wind which blew both at the time that the treatment was going on and afterwards. The average cost of applying the sulphur was about R1-4-9 per acre, including the purchase both of the cloth and also of the *kulcies* for watering. As far as could be made out, *provided the sun was strong,* bushes powdered in the morning had all the red spider killed by evening. After sulphuring the bushes were examined daily, but the only bushes on which red spider could be found were one or two which had been treated with the mixture of lime and sulphur; even here, however, very careful search was required to

find live insects. On 16th April it was noted that red spider was to be seen in all parts of the garden except the sulphured area, while neighbouring gardens were very much affected by it. The sulphured area was the first pruned and should, under ordinary circumstances, have been the most affected. With regard to the effect of the sulphur treatment on mosquito blight, some mosquito blight insects were caught and experimented with on 23rd March. When sulphur was powdered on to them it adhered to the hairy parts of the body and legs to a considerable extent, but the insects did not die at once, though putting them in this state under a glass in the sun was fatal to them. After applying the sulphur all signs of blight disappeared, careful search not revealing a single punctured shoot. It must be added that little blight could be found on other parts of the garden, but the flats which had been treated with sulphur were always the ones to be first attacked.[1]

6th May 1892.—"I have no objection whatever to Mr. Cotes making use of any information he may have derived from my writings, and will be glad to supply him with further notes from time to time. I strongly object, however, to trying Mr. Cotes' suggestion about sulphur soap instead of the pure sulphur (except as a supplementary experiment) for this reason.[2]

"The action of sulphur against red spider is now proved beyond doubt, and requires no comment. It also seems to have killed off the blight insect; and if this is a fact it would be a vast pity to operate against the one disease without the other in future, for the sulphur soap wash, however efficacious against spider, could not be expected to do much harm to a winged insect like blight. Moreover, the wash requires special apparatus for application, and the purchase of such insufficient quantity to go over hundreds of acres quickly would be prohibitive. That blight has actually been killed out over the sulphured area seems to me a certainty. On the 14th March I wrote to you saying that my original plan of distributing the sulphur had been changed owing to a considerable amount of blight being noticeable. This is proof that blight *was* there; it is equally certain there is none *now*, and the accompanying extract from my diary will prove that during the past ten years I have invariably reported blight not later than the week ending the 23rd April, and almost always in the same spot, which this year is free. I am not yet in a position to ask you for a further and larger supply of sulphur for next year, but trust to be able to do so when I can lay the result of the pluckings of the sulphured and non-sulphured areas before you."

23rd June 1892.—"Since the 1st June, I have been keeping a record of the pluckings of sulphured and non-sulphured areas, and on a separate sheet I give you the results. You will observe that over three weeks' plucking, the average per acre is 11lb of leaf in favour of the sulphur for every time the acre was plucked, or, say, 33lb in all. At first sight this does not appear a very large increase, but you must remember that only the worst places were sulphured, and now it is evident these sections are doing rather better than the rest. Also I have refrained from comparing pluckings till red spider was fairly on the mend; had I done so from the beginning of May the difference would have been too marked and misleading.

"Leaving out of consideration all differences between sulphured and non-sulphured areas, and taking them as of the same value, the difference in favour of the sulphured would be 44lb leaf or 11lb tea per acre for the whole month. The cost of treatment

[1] Very careful experiment will be necessary before concluding that sulphur is actually effective against mosquito blight, for the experience of entomologists in other parts of the world seems to be that while sulphur is exceedingly active against all kinds of mites (of which red spider is one), it has little effect on insects.—E. C. C.

[2] "It may be noticed that washes made of soap and sulphur combined have been recommended both in the United States and in England for use against mites like the *red spider*. The wash is sprayed on to the plants by means of a force pump fitted with a nozzle to give a very finely divided spray. This method of applying the sulphur may possibly prove cheaper and more effectual than dusting it on to the leaves, though Mr. Playfair's experiments with sulphur in powder seem so successful as to leave little to be desired. Compounds of soft soap and sulphur can now be purchased in England ready made, so as only to require the addition of water. In her fifteenth annual report on Injurious Insects, Miss Ormerod mentions the Chiswick Soap Co., of Chiswick, England, as a firm from which the mixture can be procured."—(*Extract from "Indian Museum Notes."*)

amounted to R8-4 annas per acre, so that with tea at 6 annas per pound all expenses would be recovered in two months.

"I am quite convinced, however, that the sulphur will give me quite one maund of tea per acre by the end of the year."

23rd June 1892.—

Date.	Sulphured.		Non-sulphured.		Remarks.
	Acres.	Outturn. Mds. ℔	Acres.	Outturn. Mds. ℔.	
June 1	77·25	43 43			Indigenous omitted from both. Thirty acres of non-sulphured manured with oil-cake, against no manuring on sulphured area.
2	31	19 47			
3			60·25	55 65	
4			36	44 14	
6	33	46 45			
7	19·25	19 10	13·25	15 5	
8	64·50	39 48			
9	6	8 46	25	20 38	
10			62	52 50	
11			8·50	10 4	
13	44·25	32 59			
14	34	27 45	3	2 40	
15	19·25	18 55	21·50	15 39	
16	22·50	27 39	50·75	23 25	
17			30	16 20	
18			7	4 18	
20	41·25	29 55			
21					
Total	322·25	310 12	317·25	259 76	
		77		66	Average per acre each plucking.

14th May 1893.—"I had bad luck as regards weather, March being a wet month this year. Reserving 2 cwt. for experimental purposes, the balance of 5 tons of flour of sulphur was applied to 135 acres, of which 85 acres had good sunshine for between ten and fourteen days before being washed by rain; 28 acres for two days; and 22 acres were powdered in the morning and washed in the evening. Still the effect seems to be much the same over the whole area which is *practically* free of spider. I qualify the latter statement, as a bush every here and there does show up red this year, which was not the case in 1892. The number is altogether insignificant, being under 1 per cent., but I mention the fact as being curious and unlike the past season's experience.

"The only point worth noting this year is, that a single day's good hot sunshine appears sufficient for the sulphur to do its work.

"The 138 acres treated in 1892 have for the most part very little spider. Some of the worst sections, especially those subject to flooding, show up a little red, but not one quarter as bad as in former years; on the other hand, there are large stretches with no spider at all.

"On the first signs I went over 72 acres with the one cask of 2 cwt. reserved for the purpose, sprinkling every bush that gave the slightest show. From the ground gone over

and quantity of sulphur used, I calculate the affected bushes amounted to just 3 per cent. With a little more sulphur I could have checked the disease over the remainder of the 138 acres, for I am glad to say the 72 acres are now quite free, whereas the rest have perhaps 10 per cent. of the bushes red. The 11 acres treated with sulphur and lime which I reported as unsuccessful last year have at least 50 per cent. attacked.

"Now that I know more about sulphur and its effects, I am convinced I made a great mistake in not applying it immediately after pruning. I have several reasons for saying so, amongst which are—(1) Red spider must hybernate somewhere in the bush; it cannot come spontaneously. One invariably sees it start on the old leaves, and work gradually up to the new growth which is always the last attacked, and I should not be surprised to learn that it remained through the cold weather in the *bark*. Therefore an application of sulphur in January ought to be as successful as in March. (2) The sulphur would go very much further on newly-pruned bushes, and would also *search out the bark*, which it cannot do after the leaves form a covering. Moreover, there would be no fear of heavy rain for at least two months, nor would there be the high winds of February and March which waste a good deal of sulphur. (3) Although Mr. Cotes is not convinced on the subject, I still hold to my opinion that sulphur has an influence on blight. My experience of this year is exactly that of last,—*viz.*, that on the sulphured area there is still no blight, but a good deal on other places; in fact it is unusually bad for the early season of year."

Late pruning *versus* red spider.

The following is an extract from an interesting report by Mr. A. H. Green upon the subject of late pruning as a check on red spider in Assam. It has been furnished through the kindness of Messrs. Barry & Co.[1]

8th May 1893.—"The weather has been unusually cold for time of year. Red spider has also been showing on parts of gardens, but is getting less. The gardens promise well, and with suitable weather should soon make up and pass last year.

"In connection with red spider, it may be of interest to you to note that this blight rarely, if ever, attacks bushes pruned after the last week in March. For three years I have kept small plots of bushes unpruned till last week of March, and this year I kept some 30 acres unpruned till after third week of March, the difference of the plots so treated being now very marked; that portion of same plot early pruned being more or less covered with blight, and the later pruned throwing out shoots without a sign of blight.

"My neighbour at Coolie Kusie has tried the same experiment with so far like result. I am of opinion that late pruning—not before first week in April preferably—will be found the best remedy or rather preventative for this blight; the bushes liable to it will probably get the blight on them before they are pruned, but the pruning will remove a good deal, and the bush will throw out shoots straight away without a check.

"Blighted bushes give little or no leaf for several weeks, and the little leaf given before they become attacked by the blight, would probably be more than made up by the unpruned bush up to beginning of April.

"I am referring to ordinary or light-pruned tea; heavy pruning is probably best done early, and, further, red spider does not attack heavy-pruned tea as a rule."

Mites other than Red Spider.—In India red spider (*Tetranychus bioculatus*, W. M.) is the only mite which has hitherto been recorded as attacking the tea plant, but in Ceylon the two totally distinct species *Typhlodromus carinatus* and *Acarus translucens* have been discovered by

[1] It should be observed that in Ceylon a bad attack of red spider is said to be very liable to follow a few months after heavy pruning (*vide* Green, *Insect Pests*, No. 7).—E. C. C.

Green, who found that they were responsible for much of the damage commonly attributed to red spider, from which, however, they should be carefully distinguished. The following is a summary of Green's observations as published in the *Ceylon Independent.*

Typhlodromus carinatus, Green. This is a minute dull-coloured mite characterised when full grown by a series of fine white longitudinal ridges of waxy secretion down the back. It feeds both on the upper and under surfaces of the leaves, especially along the margins. When attacked the leaves become dry and bronzed, but they do not curl up as when affected by red spider. The life-history of the species would seem to be very similar to that of red spider, but has not yet been completely traced.

Green recommends treating nurseries affected with this mite with washes of one part of kerosine emulsion to eighty parts of water, or one part of phenyle to two hundred and forty parts of water. The application to be made in the evening and followed the next morning with a washing of pure water, unless rain has fallen in the meantime.

Acarus translucens, Green.[1] This is a minute amber-coloured mite with a clouded stripe down the middle of the back. It confines its attack to the flush where it is to be found on the buds and young leaves. It seems to be unaffected by rain and continues its ravages all the year round, with the result that it occasions a large amount of damage on many estates in Ceylon. Green found the mite in all stages of development, including eggs, larvæ, and adult males and females, on the young leaves. He recommends the persistent plucking of every shoot on affected bushes.

For further particulars about these two species reference should be made to Green's work.

INSECTICIDE APPARATUS LIKELY TO BE USEFUL UPON INDIAN TEA GARDENS.

Artificial means of destroying insects are now widely employed both in the United States and in Europe, and no reason is apparent why they should not be adopted for use in India. This is especially the case where such valuable crops as tea and coffee are concerned, which are likely to repay the cost many times over in increased productiveness.

The first point to notice is the fact that the best time to employ insecticides is as soon as ever the blight appears, and without waiting

[1] In Nietner's *Enemies of the Coffee Tree,* second edition, Colombo, 1880, the name *Acarus translucens* is given to a mite found associated with the scale insect *Lecanium coffeæ,* Nietner, on coffee bushes in Ceylon. It does not appear whether the two forms are identical.

until appreciable injury has been done; for preparations which might profitably be employed to kill off the pest on the few bushes where it first appears, and thus prevent its spreading wholesale throughout the garden, are liable to prove too troublesome and expensive for application at a later date when large areas have become affected.

Methods capable of more or less completely destroying almost every form of insect blight have now been invented in America and Europe. The relative merits also of almost every substance which possesses insecticide properties have been so fully thrashed out by the United States entomologists, that little is likely to be gained by attempts to invent new insecticides in India. What is rather required is to adapt already existing systems to the special requirements of the tea industry and to ascertain by experiment how to attain the most satisfactory results with the least possible expenditure.

The period immediately after pruning, when the bushes are small and thin, is no doubt a favourable one, under certain circumstances, for treating large areas for the destruction of such pests as red spider and scale insects which remain all the year round upon the plants; but the shock likely to be caused to the bush by the application of poisonous substances must also be taken into consideration, and the object should be to select a moment for operation when the insect is most open to attack and the plant least liable to be affected.

With a few unimportant exceptions, the species which attack the tea plant in India are confined to Southern Asia; they are sufficiently closely related, however, to corresponding American and European forms to be likely to be to a very large extent amenable to the same insecticides. For this branch of the subject, therefore, the masterly publications of the United States Entomological Department are of the greatest use, though great care must be taken only to institute comparisons between species which have essential features in common.

The sulphur treatment for red spider, which has been fully described on pages 52 to 56 of this report, may be said to have already passed into the stage of practical utility in India. Sulphur has long been employed both in Europe and in America for the destruction of mites of all kinds, of which the red spider of the tea plant is one. Sulphur is therefore likely to be useful in India, not only against red spider but also against such species as *Typhlodromus carinatus* and *Acarus translucens* referred to on page 57 of this report. Whether, however, the system, hitherto adopted in Indian tea gardens, of sprinkling the sulphur in a dry powder over the bushes, will eventually prove to be the cheapest and most effectual method of application, is open to considerable doubt. Both in England and in America this system seems to have been generally abandoned in favour of mixing the sulphur with soap which is then

dissolved in water and sprayed in this form over the affected plants. Cakes of soap and sulphur mixed ready to be dissolved in water are said to be already an article of manufacture in England (see foot-note to page 54). This substance can therefore be easily procured and would seem to be well worth trying upon an extensive scale, before concluding definitely that the system at present adopted is incapable of further improvement.

Sulphur is one form or another at present to be the most promising agent for use against mites generally. From the experiments, however, which have been made elsewhere, it is almost certain to have little effect on pests which belong to the zoological group Insecta. In other words, while mites are exceedingly susceptible to sulphur, insects (properly so called) are but little affected by it.

It must be borne in mind that in order to give satisfactory results, not only must an insecticide be carefully prepared and applied in the right proportions and in the proper manner, but it is necessary to ascertain that the nature of the insect, which it is required to destroy, is such as to render it amenable to the particular form of insect poison employed. The necessary caution also must be exercised in cases where the application is hurtful to the higher animals and man.

From the contradictory statements which have been made by those who have experimented in India with identical insecticides, it appears that a good deal of misunderstanding exists with regard to the nature of these substances. In particular the fact seems to be often overlooked that because an insecticide is either effective or the reverse when applied in a particular manner against one insect, it by no means necessarily follows that it will have the same effect when used, either in the same or in some other manner, against a different species.

With this preface we may proceed to consider a few of the more important insecticides and mechanical appliances invented in America for the destruction of insects. It will be unnecessary to repeat what has already been said either about the sulphur treatment which has been fully dealt with above, or concerning such methods as that of applying bisulphide of carbon to root-feeding forms which has been sufficiently described on page 6 under the heading Melolonthini.

The subject may most conveniently be considered under the following five headings :—

(1) Kerosine Emulsion.
(2) Pyrethrum.
(3) Arsenical Washes.
(4) Hydrocyanic Gas.
(5) Hopperdozers.

Kerosine Emulsion.

This insecticide is said to be very widely used in the United States against Aphidæ, scale insects and other soft-bodied insects, which feed by sucking up the juices of plants by means of a proboscis inserted in the tissues of the plant, and which are hence little affected by non-volatile poisons distributed on the surface of the leaves. In particular it is said to have proved very valuable in Florida for ridding orange trees of scale insects.

In India it has been favourably reported upon for destroying the green scale bug, which is one of the most inveterate blights of the coffee tree, also for dislodging white ants. It is further said to have been successfully used in the Kangra Valley for destroying scale insects on tea, and has been recommended by Mr. Green to the attention of Ceylon tea planters for dealing with the five-ribbed tea mite (*Typhlodromus carinatus*, Green), the tea Aphid (*Ceylonia theæcoala*, Buckton), and such scale insects as *Chionaspis theæ*, Maskell. It is further worthy of very much more careful trial than has yet been accorded it against such insects as mosquito blight and green fly blight. For although it may be impossible, without seriously injuring the foliage, to make it sufficiently strong to destroy the winged adult forms of these species, which fly off as soon as spraying commences, it by no means follows that it will be ineffectual against the wingless larvæ which also subsist upon the tea bush, where they not only do a considerable amount of injury themselves, but also eventually develop into the winged form. No doubt the best thing would be an insecticide capable of destroying, on the first application, alike the eggs, the larvæ and the adult insects, without injury to the tea bush, but failing this it is quite possible that useful results may accrue by the persistent use of less powerful agents, provided they are really effectual against any one of the forms through which each individual insect passes the course of its existence. For, to take a single instance, it is obvious that there can be no winged mosquito blight to lay eggs, if all the wingless larvæ have been destroyed as fast as they appeared.

Kerosine emulsion is made by violently churning two parts of kerosine oil, the purer the better, with one part either of milk or, better, of soap solution; the soap solution to be made by boiling from a quarter of a pound to a pound avoirdupois of common yellow soap or whale oil soap with a gallon of water. The resulting emulsion is then mixed with from nine to fifty parts of water. The churning is best done when the mixture is warm and should be continued until a thick cream like emulsion is produced, almost like butter in consistency. In the

case of soap solution the necessary temperature may conveniently be obtained by adding it hot off the fire to cold kerosine oil.

The writer of this report has succeeded in making an excellent emulsion on a small scale by the simple process of half filling a beer bottle with a mixture of kerosine oil and milk and then setting a cooly to beat it on a pad of cloth. This process, however, is far more laborious than that recommended in the United States, where the regular plan is said to be to drive the mixture backwards and forwards for five or ten minutes through the force pump used for spraying the plants. All that is necessary in this case is to insert both the feed-pipe and the nozzle of the force pump into the mixture and then to work the pump until the thickening of the fluid shows that the union of the two liquids has been effected.

The object of emulsion is to enable the kerosine oil, which is the active insecticide agent, to mix with the water required to dilute it so as to prevent injury to the foliage, The amount of water that should be added varies according to the nature of the plant and that of the insect which it is required to destroy.

When used carelessly kerosine emulsion is certain to burn the leaves to a more or less serious extent. This is especially the case when hot sunshine follows the application, but can easily be avoided by using the wash in a sufficiently diluted state. Much also depends upon the manner in which the application is made, for to obtain the best results it appears to be essential that the spraying should be done with a force pump fitted with one of the modern "cyclone" nozzles originally invented in the United States Entomological Department. These cyclone nozzles are so arranged that the liquid issues in the form of a fine mist-like spray which envelopes the whole plant and covers every portion of it with the tiniest drops imaginable. This method of application not only makes the same amount of wash go very much further than would otherwise be the case, but the mist-like spray, penetrating as it does in all directions, is infinitely more effective, so far as killing insects is concerned, than large drops which are almost certain to leave portions of the bush untouched, besides running off on to the ground instead of adhering to the leaves.

So-called "knapsack force pumps" are now made with a reservoir which can be strapped on to the back of the operator, who thus conveniently carries a considerable supply of the wash along with him while he sprays the plants by means of an aquapult force pump fitted with a cyclone nozzle. Further improvements will no doubt suggest themselves in the form of the apparatus when it comes into general use upon tea gardens in India. It is important, however, to notice that very satisfactory force pumps are already manufactured both in Europe and in America, where they are used for various purposes.

With regard to the amount of dilution required, a mixture of twelve parts of water to one of emulsion has been recommended in America as a safe wash for ordinary purposes. In Ceylon[1] Mr. Green has found so weak a wash as one part of kerosine emulsion to eighty parts of water sufficient when applied in the evening to kill aphids and mites upon the tender shoots of tea plants in nurseries. He recommends that even this should be followed with a washing of water the next morning if no rain intervenes in the night. It will probably prove, however, that very much stronger applications can be used with safety, without subsequent washing, especially upon the older bushes, when the necessary precautions are taken to apply in a very fine spray when the sun is off the plants.

ARSENICAL INSECTICIDES.

The best known of these useful insecticides are *Paris green* and *London purple* respectively. Without going into the question of their chemical structure, it is sufficient to say that they are brightly coloured substances which are exceedingly poisonous, not only to insects but also to all forms of animal life. On this account they were for a long time looked upon with very considerable distrust. Of late years, however, it has been shown that when properly used the amount of poison which it is necessary to distribute is so small that with ordinary care they can be used with entire safety. As the result they are now employed upon a very considerable scale, especially by fruit-growers in the United States.

Like kerosine emulsion they require to be diluted to an enormous extent with water and applied to the foliage in the form of an exceedingly fine mist-like spray. The poison is thus distributed over the leaves and acts, not like kerosine emulsion by actual contact with the insects, but by poisoning the leaves upon which they feed. Paris green and London purple are thus principally effective against such caterpillars, grasshoppers, and beetles as actually eat the substance of the leaves, and are less useful against species which feed by sucking up the juices of the plant by means of a proboscis. It may be noticed, however, that satisfactory results have been obtained with London purple[2] in the Saharunpore Botanical Gardens, North-West Provinces, not only against caterpillars but also against a Jassid which attacks the flower of the mango tree, and which is closely related to the green fly blight of tea. In this case the precise action of the wash is somewhat difficult to explain.

[1] *Vide* his papers in the *Ceylon Independent.*

[2] The London purple experimented with in this case had been furnished to the India Museum by Messrs. Hemingway & Co., of 60, Mark Lane, London, E. C.

On account of their poisonous nature neither *Paris green* nor *London purple* should be used under any circumstance whatever upon tea bushes where plucking is going on. And no leaves or buds, which were in existence at the time that the spraying was done, should on any account be made into tea. Provided, however, that the bushes are well washed by rain subsequent to the application, and that sufficient time is allowed to elapse before plucking for an entirely new flush to appear, it would seem to be impossible for the tea to be affected in any way. As an additional precaution, however, it might be as well in the first instance to have the leaf tested chemically for the poison, though the fact that the closest investigation in the United States has failed to detect its presence in fruit picked from trees the foliage of which, only a few months previously, has been liberally treated with the wash, would seem to be sufficient indication that there is no possibility of danger upon this score.

The usual system for applying both *Paris green* and *London purple* is to simply mix the powder[1] with water and to spray the mixture, which is purely a mechanical one, over the plants. The powder, however, has a great tendency to settle to the bottom of the receptacle, and thus render the top too weak and the bottom too strong. To obviate this difficulty the mixture should be constantly stirred, and when empty the receptacle should invariably be rinsed out with water as a preliminary to refilling, for this prevents the accumulation of the poison at the bottom. A little flour is sometimes added to the mixture both to render it more stable, and also to help it to adhere to the leaves; this, however, is by no means essential, provided the other precautions are taken.

The precise amount of poison to be mixed with the water varies according to the nature of the insect and the resisting power of the foliage. When too strong the leaves are burnt, and when too weak the insect survives. Between these two extremes, however, there is usually plenty of room for the production of a satisfactory mixture.

For use against the web worm in the United States the following proportions have been recommended: Forty gallons of water, one quarter to three quarters of a pound of London purple and three quarts of flour, the solid ingredients to be mixed with the water by washing them through a strainer.

One pound of *Paris green* similarly mixed with from forty to one hundred gallons of water has been recommended for general use in America. In England for use upon young foliage, the proportions recommended have been one ounce of *Paris green* to ten gallons of water in

[1] *Paris green* is also manufactured in the form of paste to be similarly used. The paste has the great recommendation of not being liable to get blown about by the wind in mixing.

the case of plum trees, and one ounce to twenty gallons of water in the case of apple trees.

The precise strength, which it is desirable to adopt in each case, can only be ascertained by experiment. It should be remembered, however, that mature foliage will always stand a stronger wash than young shoots, and that, as the full effect of the poison is not always observable until three or four days after the application has been made, it is better to err on the side of making the mixture too weak rather than too strong at first.

Whether, upon the whole, *London purple* or *Paris green* is the better agent to adopt for general use in India, is a question which it is difficult to decide upon the evidence at present available. Both have their advocates, and the circumstances under which it will be found preferable to apply one rather than the other can only be ascertained absolutely by experiment.

Pyrethrum.

This preparation consists of the ground-up petals of the flower of *Pyrethrum cinerariæ folium.* It is largely used for domestic purposes and can also be employed for the destruction of caterpillars in the open. It has the great recommendation of being harmless to animals other than insects, but is unfortunately too costly for general use, under ordinary circumstances, in the field. The following extract from *Notes on Economic Entomology*, Calcutta, 1888, gives the necessary particulars about its application :—

" *Pyrethrum cinerariæfolium*, a plant native to Dalmatia, has long been known to possess insecticide properties, especially in the powder from the dried and pulverised flowers. The species has proved to be hardy throughout the greater part of the United States, and Mr. Milco of S t o n, California, has for some years cultivated it extensively with considerable profit, the product being sold under the name of "Buhach." The insecticide properties reside in a volatile oil. It acts only by contact, and its action on many larvæ is said to be wonderful, a minute quantity in time paralysing and ultimately killing. Its influence in the open air is evanescent, in which respect it is far inferior to the arsenical products; but being perfectly harmless to plants, it can frequently be used on vegetables where more poisonous substances would be dangerous.

" Pyrethrum is supposed to have no effect on the higher animals. Dr. Riley's experience, however, is that fumes in a closed room have a toxic influence, intensifying sleep and inducing stupor; while the experience of Professor Bell with the powder copiously rubbed on a dog, showed that the animal was made sick and was affected in the locomotive organs very much as is the case with insects.

" The pulverised flowers are sold at about fifty cents per pound in America. The best method of using being to pour a quart of alcohol on a pound of the powder; leave it to stand for an hour and mix with forty or fifty gallons of water to be applied with a San José nozzle, or better to let the alcohol simply percolate through the powder and thus obtain a clear tincture, which can be applied with any nozzle. The powder may also be applied with bellows or mixed with water and applied by a pump."

Hydrocyanic Gas.

The Hydrocyanic gas treatment consists in throwing a moveable tent over the bush so as to confine the air and then fumigating the interior with Hydrocyanic gas. The gas is produced in the simplest possible manner by slipping inside the tent a saucer containing a little weak sulphuric acid into which a lump of potassium cyanide is dropped. The system has only been invented during the past few years, but is said to have already been adopted upon a very large scale for the destruction of scale insects upon orange trees in California. When carefully applied it is claimed to destroy, not only scale insects, but also almost every other form of animal life inside the tent, without injury to the orange tree, and it is likely to be almost equally satisfactory for tea bushes. In this case only a very small tent would be required and the whole process could easily be worked by a couple of coolies trained for the purpose. So promising indeed does it appear for use upon tea gardens that it is only surprising it has hitherto attracted so little attention.

The following extract from a report by Mr. D. W. Coquillet, published in the United States Department of Agriculture, Division Entomology, Bulletin No. 23, gives all the necessary particulars concerning the treatment, so far as orange trees are concerned. For tea bushes the only modification likely to be required is to reduce the size of the tent and to use proportionately less of the chemicals.

"Briefly speaking, this process consists in covering the infested tree with an air-tight tent, and afterwards charging the tent with hydrocyanic gas. The material commonly used in the construction of the tent is what is known as blue or brown drilling. A few persons have used ducking instead of the drilling, but this is much inferior to the latter; in the ducking the threads of which it is composed extend only lengthwise and crosswise, whereas in the drilling they also extend diagonally—this belonging to the class of goods to which our merchants apply the term "twilled"—and for this reason the drilling is both stronger and closer in texture than the ducking.

"After the tent is sewed up it is given a coat of black paint, as it has been ascertained that tents treated in this manner last longer than those which have been simply oiled with linseed oil. Some persons mix a small quantity of soap suds with the paint in order to render the latter more pliable when dry, and therefore less liable to crack; instead of thus painting the tent some persons simply give it a coating made of an inferior glue called "size," first dissolving this in water and then covering the tent with it, using a whitewash brush for this purpose. Sometimes a small quantity of whiting or chalk (carbonate of lime, $Ca\ Co_3$) is added to this sizing with or without the addition of lamp-black. A few make use of the mucilaginous juice of the common actus (*Opuntia engelmanni*, Salm.) for this purpose; to obtain this the cactus leaves or stems are cut or broken up into pieces, thrown into a barrel and covered with water, after which they are allowed to soak for three or four days; the liquid portion is then drawn off, and is ready for use without further preparation. Tents which I saw that had been prepared with this substance were to all appearances as air-tight and pliable as when prepared in any other manner.

"A tent 26 feet tall by 60 feet in circumference—a size large enough to cover the largest orange tree now growing in this State—if made out of drilling, and either painted or sized, as described above, will cost completed about 60 dollars. Where the trees to be treated are not more than 12 feet tall, the tent can be placed over them by means of poles in the hands of three persons; to accomplish this, three iron rings are sewed to the tent at equal distances around, and 6 or 7 feet from the bottom of the tent; immediately under each of these rings an iron hook is attached to the lower edge of the tent. When the latter is to be placed over a tree, each of the hooks is fastened into the corresponding ring above it; one end of a pole is then inserted into each of these rings, and the tent is raised and placed on the tree. The hooks are then released from the rings and the lower edge of the tent allowed to drop upon the ground.

"Instead of allowing the tent to rest directly on the tree, some growers use an umbrella-like arrangement, the handle of which is in two pieces, which are fastened together with clamps provided with pins; this allows the handle to be lengthened or shortened according to the height of the tree. This apparatus is put up over the tree, and the tent allowed to rest upon it. By the use of this simple device the danger of breaking off the small twigs on the upper part of the tree by the weight of the tent is avoided. Mr. Leslie, of Orange, used four tents and tent rests of this kind, and he informs me that with the aid of two men he fumigated 120 trees in one night. To remove the tent from one tree, place it over another, and charge the generator required only one minute and a half. In the place of poles some persons attach a circle of gas pipe to the lower edge of the tent; then two men, each taking hold of opposite sides of this circle, threw the tent over the tree. Dr. J. H. Dunn, of Pomona, informs me that four men, using six tents like the above, fumigated 240 orange trees in one night, and that the average for each night was over 200 trees, the latter being 8 feet or less in height. After the tent is placed over the tree, the next step is to charge it with the gas. The materials used for the production of the gas consist of commercial sulphuric acid ($K_2\ SO_4$), fused potassium cyanide (KCN), and water, the proportions being one fluid ounce of the acid, one ounce by weight of the dry cyanide, and two fluid ounces of water. The generator is placed under the tent at the base of the tree; it consists of a common open earthenware vessel. The water is first placed in the generator, then the acid, and last the cyanide, after which the operator withdraws to the outside of the tent and the bottom of the latter is fastened down by having a few shovelfuls of earth thrown upon it. The tent is allowed to remain over the tree for a period of from fifteen to thirty minutes, according to the size of the tree.

"It was found by experimenting that the trees were less liable to be injured by the gas when treated at night than they were when operated upon in the day-time, and at the same time the gas is just as fatal to the scale insects when applied at night as it would be if applied in the day-time; and, indeed, it appears to be even more fatal when applied at night. This is accounted for by reason of the fact that in the day-time the light and heat decompose the gas into other gases which, while being more hurtful to the trees, are not so fatal to insects. At night the trees are also more or less in a state of rest, and, therefore, are not so liable to be injured by the gas as they would be in the day-time, when they are actively engaged in absorbing nourishment and replacing wasted tissue with new materials.

"Of the different materials used in generating the gas, the most important is the potassium cyanide; of this there are three grades; the mining cyanide, commercial cyanide, and the C. P. (chemically pure). Of these three brands, the mining cyanide is wholly unsuitable for the production of the gas, and the C. P. is too expensive; the commercial brand (fused) is the only one that is used for producing the gas, but even this varies greatly in strength, containing all the way from 33 to 58 per cent.

of pure potassium cyanide. It is, therefore, of the utmost importance that the operator should know the exact percentage of pure potassium cyanide that his cyanide contains, and when large quantities of it are purchased at one time it would be advisable to obtain one or more analyses of it by a reliable analytical chemist; or if it is not possible to submit the cyanide to such person, an analysis of it could be made by almost any person accustomed to the use of chemicals or drugs.

"The only substance required for this purpose is the crystals of nitrate of silver ($AgNO_3$), which may be obtained at almost any well-stocked drug-store. Dissolve the nitrate in cold water contained in a glass or earthen vessel, using one-fourth of an ounce (Troy) of the crystals to one pint of water; this dissolves in a few minutes, forming a whitish, semi-transparent solution. The cyanide, when dissolved in water, forms a transparent, nearly colourless solution; when a small quantity of the nitrate of silver solution is added to this it at first spreads out in a white cloud, like milk, but it soon breaks up into small, white, floccy pieces which gradually disappear upon being agitated, leaving the solution nearly as transparent as at first; when more of the nitrate of silver solution is added from time to time, the above process is repeated except toward the last, when the cyanide solution becomes somewhat milky, but it still remains semi-transparent, permitting the operator to see quite clearly the bottom of the vessel containing the solution. As soon as a sufficient quantity of the nitrate of silver solution has been added to the cyanide solution, the latter immediately becomes white and opaque, like milk, completely concealing from view the bottom of the vessel containing it. This completes the operation, and the quantity of nitrate of silver solution used will indicate the strength of the cyanide tested. When absolutely pure, $5\frac{3}{4}$ grains of the potassium cyanide dissolved in water will require one fluid ounce of the above nitrate of silver solution before the turbidity occurs, indicating that the cyanide is 100 per cent. strong; if only one-half of a fluid ounce of the nitrate of silver solution produces this turbidity, this indicates that the cyanide is only half strength, or 50 per cent. strong; if only one-fourth of a fluid ounce is required, then the cyanide is 25 per cent. strong; and so forth. The nitrate of silver solution should be added to the cyanide solution very slowly, the latter being agitated by gently shaking it each time that any of the nitrate solution is added. Wherever any of the nitrate of silver solution comes into contact with the skin or nails of the hand it produces a reddish or black stain, which can easily be removed by washing the stained part in a solution of cyanide and water; this will quickly remove the stain without causing any injury to the parts affected, except, of course, when the stains occur upon a sore or cut in the hand, in which case it would be dangerous to apply the cyanide to these places.

"It sometimes happens that the percentage of syanogen (CN or Cy) is given instead of the percentage of potassium cyanide (KCN or KCy); but in cases of this kind the percentage of cyanide can be readily ascertained by always bearing in mind that two-fifths of a given quantity of potassium cyanide is cyanogen. Thus, if a certain brand of cyanide contains 24 per cent. of cyanogen, this is equivalent to 60 per cent. of pure potassium cyanide. Potassium cyanide when absolutely pure (equal to 100 per cent.) contains 40 per cent. of cyanogen; and, therefore, no grade of cyanide could contain a larger percentage of cyanogen than this.

"The potassium cyanide used for producing the hydrocyanic acid gas is principally manufactured by two firms: Power and Weightman, of Philadelphia, Pa., and the Mallinkrodt Chemical Works, of St. Louis, Mo. That made by the first-named firm is the most largely used; when purchased by the ton the price is 36 cents per pound for the grade containing about 57 per cent. of pure potassium cyanide, packages and carriage extra. It is put up in tin cans holding 10 pounds each, and also in

barrels holding about 400 pounds each. That in the cans is much to be preferred, since the quantity in each is so small that it will soon be used up after the can is opened; whereas the barrel containing so large a quantity, the cyanide used towards the last will have lost much of its strength by contact with the air. It is customary to weigh out the cyanide in small paper parcels and mark each parcel with the number of ounces of cyanide that it contains: then when the tree is to be fumigated, it is an easy matter for the operator to select one of the parcels containing a sufficient quantity of the cyanide for the tree, thus saving the trouble of weighing out the cyanide as it is to be used for each tree. As the fumigating is done only at night, the weighing of the cyanide is frequently done by the ladies of the house upon the day preceding its use.

"The quantity of cyanide to be used on each tree will, of course, depend not only on the size of the tree but also on the strength of the cyanide used. The following table will aid in determining the proper quantity of each ingredient to be used on different-sized citrus trees, the cyanide being about 58 per cent. pure:—

Height of Tree.	Diameter of Tree-top.	Water.	Sulphuric Acid.	Potassium Cyanide.
Feet.	Feet.	Fluid ozs.	Fluid ozs.	Ounces.
6	4	⅔	⅓	⅓
8	6	2	1	1
10	8	4½	2¼	2¼
12	10	8	4	4
12	14	16	8	8
14	10	10	5	5
14	14	19	9½	9½
16	12	16	8	8
16	16	29	14½	14½
18	14	26	13	13
20	16	36	18	18
22	18	52	26	26
24	20	66	33	33"

HOPPERDOZERS.

These appliances have been invented in the United States for the destruction of grasshoppers and other active insects which lurk in low vegetation. The value of the crops saved by the use of hopperdozers in the States of North Dakota and Minnesota alone in the year 1890 has been estimated by the Dominion Entomologist of Canada[1] at no less than two hundred thousand dollars. Hopperdozers are likely to be of use upon Indian tea gardens, not only for destroying grasshoppers in the weeds about the tea bushes, but also for catching such insects as the active larvæ of the mosquito blight which drop off the bushes when disturbed.

The forms in use in the United States vary a good deal in construction. The essential feature in each case, however, consists of an open pan

(1) See his address to the Association of Economic Entomologists, Washington, 1891.

containing either kerosine oil or coal-tar, which is drawn along over the ground in such a manner that many of the insects disturbed in its progress fall into the tray, where they are either entangled in the coal-tar from which they are unable to extricate themselves, or are poisoned by the action of the kerosine oil, which rapidly proves fatal to them.

The following extracts from an admirable report by Dr. C. V. Riley, United States Entomologist, on *Destructive Locusts*, Washington, 1891, give full information upon the subject of methods of construction and utilisation :—

"The pans that were used in Kansas and Iowa, but principally in the former State, were of very simple construction and very effectual.

"A good and cheap pan is made of ordinary sheet iron, 8 feet long, 11 inches wide at the bottom, and turned up a foot high at the back and an inch high at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner, complete the pan at a cost of about $1.50. . . . .

"We have known from 7 to 10 bushels of young locusts caught with one such pan in an afternoon. It is easily pulled by two boys, and by running several together in a row, one boy to each outer rope, and one to each contiguous pair, the best work is performed with the least labour. Longer pans, to be drawn by horses, should have transverse partitions . . . to avoid spilling the liquid; also more runners. The oil may be used alone so as just to cover the bottom, or on the surface of water, and the insects strained through a wire ladle. When the insects are very small, one may economise in kerosine by lining the pan with saturated cloth, but this becomes less efficient afterward, and frames of cloth saturated with oil do not equal the pans. Where oil has been scarce, some persons have substituted concentrated lye, but when used strong enough to kill it costs about as much as the oil. The oil pans can be used only when the crops to be protected are small.

"Small pans for oil, attached to an obliquing pole or handle, do excellent service in gardens.

"Mr. A. A. Price of Rutland, Humboldt County, Iowa, sends the Commission the following description of a coal oil pan to be drawn on runners, and which was used with much success in North Western Iowa. . . . Take a common board from 12 to 16 feet in length for the foundation or bed-piece. Make a tin trough 4 inches deep, 6 inches wide, and as long as required. Divide the trough into partitions by means of strips of tin, so that each partition is a foot long, thus avoiding the spilling of oil. Back of this place a strip of tin 16 inches wide and as long as the trough. The back must be firmly secured by braces running down to the front edge of the board. Under all this place three wooden runners 3 feet long and shod with iron for the trough to ride on. Fill the pan half full of water, and then add a small quantity of kerosine sufficient to cover the water. A horse may be hitched to the machine by fastening a rope to the outside runners. . . . . The lightness of the machine will allow of its being used on any crops." . . . .

"A machine of this sort was patented by Mr. Lorenzo B. Canfield, of Syracuse (Patent No. 187,509, dated Nebr., February 20th, 1877)." . . . .

"This pan was sold in the west at an exorbitant price, $4 being charged for royalty. Wherever we had an opportunity we advised farmers not to use it. but to construct others such as we have already described, and every bit as good, at far less

expense. The principle cannot be patented, for since 1875 similar coal-oil pans, virtual outgrowths of the canvas frames originally employed for the same purpose, have been 'known and used' in Colorado. This fact is sufficient in law to defeat any patent right based upon any application for a patent subsequent to such knowledge and use.

"The essential features in all the contrivances are in fact—(1) a platform that runs on the ground, on runners or wheels; (2) a canopy at right angles with it; (3) a reservoir at the junction to contain the liquid.

"Another pan . . . . was made by Mr. James Adams, of Abilene, Kansas. It is 10 feet long, 2 feet wide; back (*a*) 1 foot high; front (*b*) about 2 inches high at the inner edge; ends (*c*) 2 feet high. The front is made of a board 6 inches wide, leaning inward at an agle of about 45°. A cloth screen is placed on the back part, which prevents the reel from knocking the locusts back over the pan.

"The whole is made of pine, and it costs $8 or $10. The pan is painted within with asphaltum paint, which renders it impervious to water or oil. The pan rests in front upon runners, to which ropes are attached for drawing, and on wheels behind which carry belts to turn the reel.

"The reel revolves just in front of the pan, causing the locusts to hop, and then knocking them into the pan. A brush of cloth is sometimes fastened to one arm of the reel to brush into the pan any locusts that may be on the frent-piece. Several of these pans were used about Abilene, and did good work.

"A contrivance . . . . was constructed by President John A. Anderson for use on the Agricultural College farm at Manhattan, Kansas.

"It was found to do very good service, killing the young locusts in considerable numbers. The oil did not evaporate so rapidly as was anticipated. One thorough saturation was sufficient for fifteen or twenty minutes, when a little more could be added. If the machine be hauled against [the wind, nearly all the locusts which hop will touch the oiled canvas. They generally take several hops upon the canvas before leaving it, thus ensuring a thorough saturation with the oil. After hopping from the apron they can take two or three hops upon the ground, then lose all power in their hind legs, stretching them straight out behind, and finally, in one or two minutes after being 'oiled,' they are dead.

"*Coal-tar.*—This may be used with most of the contrivances just described for the use of kerosine, and while not equal to the simple kerosine pan for speed in trapping and destroying, is yet very useful, especially in the neighbourhood of gas works, where the coal-tar can be obtained at nominal cost. It also permits the use of the simplest kind of pan. Enough tar is spread over whatever receptacle may be used to cover well the bottom, and when this becomes sufficiently matted with the young locusts so as no longer to destroy the new-comers, another coating is added, and so on until it becomes necessary to remove the whole mass, when it is shovelled from the pan and burned, or, what is far preferable, wherever there are wet ditches it may be thrown into these, when the oil contained in it, spreading over the surface of the water, destroys such locusts as may jump into or be driven into such ditches. Where the tar is scarce, as a matter of economy it will pay to melt the accumulated mass in iron vessels. By skimming off the dead locusts that rise to the surface, and thinning the residuum with a little coal-oil, it may be used again.

"A simple pan extensively employed . . . . was known as the Robbins 'hopper-dozer,' . . . the general plan being that of the ordinary road scraper. Its simplicity

and durability account for its general use. It was usually drawn by hand, though several pans were frequently bound together and drawn by horses; while, in some instances certain improvements in the way of mounting on wheels, so as to permit its being pushed from behind, were also adopted. We saw some with a wire screen or over hinge to the back, so that the insects might be secured when the pan was not in motion: but the cover seemed superfluous. We also saw lime and kerosine mixed so as to form a mortar substituted for the coal-tar."

CALCUTTA;
28th March 1894.

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G. I. C. P. O.—No. 19 R. & A.D.—8-5-95.—13,00.

A DECADE OF ENTOMOLOGY IN THE INDIAN MUSEUM. 1884—1894.

BY E. C. COTES.

The following summary of what has been accomplished during the past ten years in the Entomological Section of the Indian Museum may appropriately find a place in *Indian Museum Notes*, a publication which owes its origin to the economic investigations that have formed an important department of the work.

Unlike other portions of the Indian Museum the Entomological Section did not receive any large contingent of specimens from the old Asiatic Society Museum. On the contrary it was not until Dr. Anderson was appointed Curator that any persistent attempt seems to have been made to gather together representatives of the general insect fauna of India.

When the writer of this note first took charge of the Entomological section in 1884, the collection, which had up to this period been successively cared for by Messrs. Wood-Mason, Nevill, and de Nicéville, consisted for the most part of specimens collected in the Andaman and Nicobar Islands by Mr. de Roepstorff, in Assam by Mr. S. E. Peal and in Kulu by Mr. A. G. Young. There were also a large number of miscellaneous insects procured for the Museum by native collectors employed in various parts of India, besides the entomological results of the deputation of that enthusiastic Zoologist, Mr. Wood-Mason, at first to the Andaman Islands and afterwards to Cachar. There was also a considerable set of Rhynchota bequeathed to the Museum by Dr. Ferdinand Stoliczka.

By far the most valuable series belonging to any one entomological group in the Museum was a fine set of butterflies, largely consisting of specimens collected with his own hands by Mr. Lionel de Nicéville, who had for four years previous to joining the Museum been patiently working at the Rhopalocera of the North-West Himalayas. There were also a few drawers of named Indian Coleoptera in poor preservation from the old East India Company's Museum in London, and a small set of named New Zealand Coleoptera furnished by Captain Broun.

The whole series of butterflies had been named and excellently arranged by Mr. de Nicéville, who had also identified, as far as was possible in the then state of the literature of the subject, the Sphinges anp the first few families of the Bombyces. Mr. Wood-Mason was working at the Mantidæ, of which he had collected a fine series for the Museum: he had also identified a number of the Phasmidæ besides naming such miscellaneous species belonging to other groups as could be determined from such works as Westwood's *Cabinet of Oriental Entomology*,

Donovan's *Insects of India* and Westwood's *Arcana Entomologica.* The *Passalini* had been named by Dr. Stoliczka, and a small set of miscellaneous insects collected by that intrepid explorer on the Yarkand Mission, shortly previous to his death, were afterwards returned to the Museum by the late Mr. E. W. Janson, who had circulated them to various well-known entomologists in Europe, and in this way procured the identification of a large proportion of the species.

Since 1884 the Museum collections have been steadily growing, partly by presentations, partly by the work of native collectors who have been employed, whenever funds have admitted, to collect specimens in various parts of India and Burma, and to a small extent by purchases. The specimens recorded in the general register, which is chiefly, though by no means exclusively, taken up with insects, stood at somewhat under twenty thousand in the beginning of 1884. The number of entomological accessions since recorded in the Annual Museum Reports amounts to sixty-seven thousand. This, however, by no means represents the total increase which has taken place during the decade, for of late years, under the orders of the Trustees, passed at the suggestion of the late Mr. E. T. Atkinson, with a view to saving space in the register, large numbers of miscellaneous entomological specimens of which only the locality of collection and the name of the collector were known, have been ticketed individually with these particulars and do not appear on the register. It is difficult to obtain exact figures, but taking into account the numerous unregistered specimens possessed by the Museum in 1884, it is probably rather below than above the mark to say that the collection is now four times as rich in specimens as it was ten years ago. This growth, which has been very largely due to the exertions of the late Mr. E. T. Atkinson, must be looked upon to a great extent as incidental only, for efforts have been directed, rather to the identification and study of the material already obtained, than to crowding with fresh specimens the limited number of cabinets which it has been possible to procure with the funds available.

One of the first considerable pieces of work undertaken subsequent to 1884 was to sort the various groups of insects into their natural order, the family being taken as the unit. The next was to work systematically through Gemminger and Harold's monumental *Catalogus Coleopterorum* and through the numerous entomological catalogues of the British Museum, and to identify all the species which could be determined by a comparison of the entomological works available in the libraries of the Indian Museum, the Asiatic Society of Bengal, and the Geological Survey of India. Fortunately, as the result of the enlightened policy which had been pursued in regard to them, these libraries

were very fully furnished with the works of all the more important writers upon the subject, and by their help a large number of species were identified, and the previous arrangement into families verified or corrected.

Of all the groups of Indian insects the moths, which at that time comprised an assemblage of some five thousand described Indian species, proved to be the most difficult to arrange. This was owing to the absence of any general catalogue of more recent date than the British Museum catalogue in thirty-five volumes by Walker, which had been rendered almost completely obsolete by the voluminous descriptive works of subsequent writers.

To meet the difficulty it was decided to undertake the compilation of a fresh catalogue of the Moths of India. The work was commenced systematically and shortly afterwards a most enthusiastic and able coadjutor was found in Colonel Charles Swinhoe, of the Bombay Commissariat Department, who had devoted the leisure hours of a long service in many parts of India to the study of Lepidoptera, and had amassed one of the largest amateur collections of Indian moths in existence. The catalogue proved to be a most laborious undertaking, and took more than three years to complete. In the course of the work the Museum collection was arranged, and as far as possible named, the majority of the species being identified by Colonel Swinhoe by comparison with his own collection which he had previously determined in Europe. The series was afterwards supplemented by a large set of moths from Sikkim purchased from the estate of that excellent collector, the late Mr. Otto Möller, and determined in England by Mr. Elwes.

In the meantime steps were taken to enlist the co-operation of Entomologists in all parts of the world in working out other groups of insects contained in the Indian Museum. Cordial support in the scheme was received from the late Mr. E. T. Atkinson, who was at that time chairman of the trustees, and who took an active part in sending out circular letters, and in securing sanction for the despatch of Museum specimens to Europe. Mr. Atkinson also himself undertook to determine the Rhynchota. He further ticketed with his own hands many of the Coleoptera that were returned after examination by other Entomologists.

As the result of the action that was taken, a number of Entomologists in different parts of the world consented to examine the Museum collections of the different groups to which they had respectively devoted their attention, the understanding being that they might take what duplicates they wanted for their own collections, but should return, in each case, a complete set, including all unique specimens, to the Museum. A large

number of groups were despatched to Europe on these terms, and, with a few exceptions, the arrangement worked satisfactorily.

In the end the Museum representatives of the following groups of insects were more or less completely determined by the Entomologists mentioned below :—

Chrysomelidæ, by the late Mr. Joseph Baly and Mr. Martin Jacoby.
Melolonthini, by Herr Ernst Brenske.
Prachycera, by Mons. J. M. F. Bigot.
Chrysididæ, by Mons. le Vicomte Robert du Buysson.
Elateridæ, by Dr. Candeze.
Cerambycidæ, by Dr. Lameere.
Curculionidæ, by Mons. J. Desbrochers des Loges.
Ephemeridæ, by Revd. A. E. Eaton.
Cicindelidæ, by Lord Dormer and Mons. Edmond Fleutiaux.
Eumolpidæ and Clytridæ, by Mons. E. Lefevre.
Staphylinidæ, by Mons. A. Fauvel.
Malacodermidæ, Endomychidæ, etc., by the Revd. H. S. Gorham.
Cucujidæ and Silphidæ, by Mons. A. Grouville.
Cetonini, by Mr. O. E. Janson.
Buprestidæ, by Mons. Kerremans.
Histeridæ, by Mr. George Lewis.
Odonata, by Mons. le Baron de Selys Longchamps.
Dynastini, by Mons. A. F. Nonfried.
Dytiscidæ and Gyrinidæ, by Dr. Regimbart.
Coprini, by Dr. D. Sharp.
Saltatoria and Blattidæ, by Dr. Henri de Saussure.
Aculeata (except Formicidæ), by Major Bingham and Dr. Henri de Saussure.
Formicidæ, by Mons. Forel, Mr. Wroughton, and Surgeon-Captain J. H. Tull Walsh.
Tachinæ, by Herr F. M. Van der Wulp.
Rhynchota, by Mr. E. T. Atkinson, in collaboration with Mr. W. L. Distant, Mons. Bergroth, Mons. Fairmaire and others.

In connection with the work of arranging the collections an extensive series of catalogues of the different groups of Oriental Insecta, to be published by the Asiatic Society of Bengal in co-operation with the Indian Museum, were initiated by Mr. E. T. Atkinson, who himself undertook to list the Rhynchota and the Coleoptera. The undertaking unfortunately fell through when Mr. Atkinson died, but his catalogues of the families Cicindelidæ, Carabidæ, Dytiscidæ, Gyrinidæ, Paussidæ, Hydrophilidæ, Silphidæ, Corylophidæ, Scydmænidæ, Pselaphidæ, Staphylinidæ, and Capsidæ, which actually appeared in connection with the Journal of the Asiatic Society, are a monument to his zeal and industry. Mons. Bigot's catalogue, again, of the Oriental species of Diptera, published in the same series by the Asiatic Society, and Mr. Distant's monograph on *Oriental Cicadidæ* published by the Trustees of the Indian Museum, alike

testify to the warmth with which the scheme was taken up by Entomologists in other parts of the world. Reference may further be made in this place to an excellent descriptive catalogue of the Mantidæ of the world commenced independently on behalf of the Museum by the late Mr. Wood-Mason, who has not been spared to finish his undertaking.

The review would not be complete without some mention of the life-work of Mr. Lionel de Nicéville, whose official connection with the Museum was severed in 1884, but who has since continued to make it his head-quarters for the prosecution of his studies connected with the Rhopalocera. His extensive work on the *Butterflies of India*, originally undertaken in collaboration with Major G. F. H. Marshall, and for the past nine years industriously continued by himself alone, is now advancing towards completion. Not only is it, as a whole, the standard work on the subject with which it deals, but each successive volume contains a greater wealth of information than its predecessor.

While the gradual arrangement of the collections was proceeding in the Museum, attention was from time to time drawn to the enormous extent of the damage annually caused to agricultural crops in India by insects of many kinds. Previous to 1884 Mr. Wood-Mason had been deputed to investigate the subject of the tea-bug and tea-mite of Assam, and had also, from time to time, furnished what information was available about other injurious species. No attempt, however, had been made to deal with the matter systematically. Indeed, owing to the unarranged condition of the general collection, it was quite impossible to ascertain even the identity of the majority of the species concerned.

In 1888, on the suggestion of Sir Edward Buck, the writer of this note undertook unofficially an investigation upon the subject of the wheat and rice weevil of India. His report was published by the Government with the approval of the Trustees, as the first number of a serial entitled *Notes on Economic Entomology*. A second number of a slighter nature on Insecticides afterwards appeared in the same form, but it was apparent that further organization would be required to cope with so large an investigation as that of the insects which attack crops generally in India. The matter was taken up by the Trustees on the suggestion of Sir Edward Buck, and it was ultimately decided to make the investigation of the economic entomology of India a regular feature of the work of the Entomological Section of the Museum, the results to be published as materials accumulated, in the form of a periodical to be entitled *Indian Museum Notes* which should be issued by the Trustees and published under the authority of the Government of India, in the Revenue and Agricultural Department; the articles to be signed by their respective

contributors and no editor's name to appear on the title page. Funds were furnished by the Government of India, both for incidental expenses and also for the entertainment of a small subordinate staff of assistants who were thereupon got together and gradually trained for the work. The writer of this note was deputed to attend an agricultural conference at Delhi, where the part to be taken by the various local governments was discussed.

Cordial support was afforded by all the Directors of Land Records and Agriculture in the different provinces, and through them circular letters were sent out inviting the co-operation of officials and others interested in agriculture in all parts of India.

As the result a stream of reports from all sides poured in upon the Museum, accompanied by specimens of insects destructive to crops.

The material that was furnished proved to be very unequal in merit, for while much was of the greatest interest, a large proportion was found to be almost entirely worthless owing to ignorance of natural history on the part of the senders. The whole of it was none the less carefully examined, and all the information that could be extracted was recorded in *Indian Museum Notes.* One report and one set of specimens often supplemented another, and little by little, by dint of constant correspondence pointing out what had already been ascertained and indicating the nature of the specimens and information required to enable the blanks in the record to be filled up, a large number of the destructive species were identified, and many portions of their life histories pieced together. The information gathered in this manner was supplemented, whenever live specimens could be procured, by rearing them through as many stages as possible in the Museum, and from time to time particular groups, as for instance the diverse silk insects and locusts of India, were made the subject of more special investigation.

This system, continued for six years, has gradually resulted in the accumulation of a very considerable mass of information which has been carefully recorded in the form of more or less fragmentary notices in the numerous parts which make up the three volumes of *Indian Museum Notes* issued since the project was started.

During the whole course of investigation much generous help in connection with the examination of specimens has been received from entomologists in different parts of the world, who have also described a good many of the new species that have been brought to light. Papers have been furnished for publication in *Indian Museum Notes* by Lord Walsingham, Mons. J. M. F. Bigot, Mons. L. Lethierry, Herr Van der Wulp, Major C. T. Bingham, and Messrs. E. T. Atkinson, W. M.

Maskell, G. C. Dudgeon, P. Moore, W. L. Sclater, L. de Nicéville, W. F. H. Blandford, G. B. Buckton, O. E. Janson, F. A. Skuse and R. Newstead; while the kindly sympathy and advice from time to time afforded by different members of the United States Entomological Department, and especially by Dr. C. V. Riley, the United States Entomologist, also from Miss Ormerod and others engaged in the study of Economic Entomology in different quarters of the globe, has materially lightened the burden of the work.

In connection with the determinations adopted for those insects which it has been necessary to identify specifically in Calcutta, correction will frequently be required hereafter. This has been unavoidable owing to the confused state of much of the literature connected with Indian Entomology, and to the great difficulty experienced in getting specimens compared with the original types which are mostly preserved in Europe. Provided, however, that the system of carefully preserving, not only the specimens themselves, but also the original, and all the tickets on each specimen in the Indian Museum collection, be as rigidly adhered to in the future as it has in the past, no confusion will arise on this account, and no difficulty will be experienced in making the necessary corrections, as the more complete working out of the various groups renders this possible.

The Museum now possesses large and representative, though by no means complete, collections of all the more important groups of the insect fauna of India. These have been arranged and named to the extent of making it possible to determine with very considerable accuracy the great majority of the commoner, besides many of the rarer species. At the same time the nature of most of the more important species which affect crops has been ascertained, and their habits in a large number of cases to some extent traced.

The subject is so vast that what can be done by any one individual or group of individuals in the space of ten years must necessarily be comparatively insignificant, when measured by that which remains to be accomplished. But it is not too much to claim that many of the preliminary difficulties have been overcome, and at least one stage of the path laid out for further advance.

PARASITIC MUSCIDÆ FROM BRITISH INDIA.

BY F. M. VAN DER WULP,

(*with plate I*).

The Trustees of the Indian Museum at Calcutta have been so kind as to send me for examination a small collection of Muscidæ, reared in British India from Lepidopterous larvæ and pupæ or from other insects. Among them are also typical specimens of *Tricholyga bombycis*, Becher, and of the Tachinid fly, determinated by Bigot as *Masicera grandis*, Walker. The others, as far as I am able to make out, are undescribed species, and must be considered as fresh additions, to the immense variety of forms belonging to the large group of parasitical Muscidæ.

Although represented merely by unique specimens, I have not hesitated to give descriptions and figures, which I hope will be sufficient for recognizing the species.

It would be of great interest, if every one occupying himself with rearing insects, especially Lepidoptera, did not neglect to take notice of their parasites, and preserved these with the same carefulness as the Lepidoptera themselves. The Trustees of the Indian Museum have given here the example; may it find many followers and helpers! The advancement of our knowledge on the biology of insects, and in many cases the progress of economic entomology, will highly profit by such a proceeding.

1. *Crossocosmia Sericariæ*, Rond.

Ugimyia sericariæ, Rond. Bul. Soc. Ent. Ital. II (1870), p. 137 (only the larva).

„ „ Rond. *l. c.*, p. 223.

Tachina cilipes, Macq. Dipt. Exot. II, 3 (1843), p. 62, tab. 6, fig. 6.

Masicera cilipes, v. d. Wulp, Sumatra Exped. Dipt., p. 36, pl. ii, fig. 5, (♀).

Masicera grandis, Bigot, Indian Museum Notes, I (1890), p. 211 (nec. Walker).

Crossocosmia sericariæ, Mik, Wien. Entom. Zeilschr. IX (1890), p. 309. (Of this paper a translation into English is given in Insect Life, IV (1891), p. 113.)

Of this species I have received specimens from Java, captured by Mr. M. C. Piepers, also others bred by him from caterpillars, the name of which has not been recorded. The flies agree in the most satisfactory manner with the ample description given by Prof. Mik. I also have examined a typical specimen of the Tachinid fly from British India,

parasitic on the Tusser silkworm *Antheræa mylitta*, Drury, and which has been determinated by the late M. Bigot as *Masicera grandis*, Walk. This typical specimen (a female) is altogether identical with *Crossocosmia sericariæ. Masicera* (*Tachina*) *grandis*, from East India, as described by F. Walker in his Diptera Saundersiana, p. 278; Bigot seems to have overlooked the figure which is added to the description in tabl. vii, fig. 1 (from the genial hand of Prof. Westwood). If he had given attention on this figure, he certainly would have seen that *Tachina grandis*, Walk., must be a quite other species, differing in the possession of a broader general form, the abdomen being broader than the thorax, in having irregular bristles on the outside of the hind tibiæ (in the genus *Crossocosmia* these bristles are fringe-like) in the profile of the head in which the cheeks are as high as the longitudinal diameter of the eyes, in the much shorter antennæ, etc.*

Tachina cilipes, Macq., is undoubtedly a synonym of *Crossocosmia sericariæ*. It is true that according to Macquart's description the palpi are black, but this can scarcely be considered an objection, since in some of the specimens which I have examined the rufous colour of the palpi is very obscure.

To Professor Mik's description I may add, that the vibrissæ are inserted at a short distance above the oral margin, and the anal segment is much shorter than the preceding segments. Only in some of the specimens, which I have seen, the basal joints of the antennæ are rufous, in others they are of the same black colour as the third joint. Finally the posterior cross-vein is more or less curved and shows in this respect individual variation.

2. *Crossocosmia biseriata*, n. sp. (♂ ?)

Pl. I, fig. 1.

Greyish-black; head white; frontal bristles in a double row; thorax with four black stripes; scutellum slightly rufous; antennæ and legs black; palpi rufous.

Length 9 millim.

As this species, though of smaller size, agrees in most of its characters with *Crossocosmia sericariæ*, it may be admitted, at least provisionally, in the same genus. I observe, however, that it differs in some essential points; for example, in the frontal bristles forming a double row, in the absence of orbital bristles together with the shortness of foot-claws

* Brauer and V. Bergenstamm (Denkschr. K. Akad. Wissench. Wien. LX, p. 184, note 25) suggests that *Tachina grandis*, Walk., may be the same insect as their *Nemoræa tropidobothra* (Denkschr. LVIII. p. 361), a supposition which appears to me a certainty since I am acquainted with both sexes of the latter species.

and pulvilli, in the eyes descending lower, and in having two short marginal macrochætæ on the second abdominal segment.

Head with a silvery-white pulverulence; front on the vertex as broad as the eyes, but widening towards the antennæ; frontal band blackish, narrower than the lateral portions of the front; frontal bristles very short, on each side of the band in two rows, which are very near to each other, the outward row finishing at the root of the antennæ, the inner one descending to the end of the second antennal joint; on the superior part of the front are two pairs of somewhat stouter bristles, and on the vertex a pair of still longer ones. Eyes bare. Face and cheeks broad, without pilosity; facial ridges nearly parallel, cushion-like; vibrissæ at a short distance above the oral margin, which is not at all prominent; above the vibrissæ a short row of smaller bristles, and beneath them, along the under side of the head, a series of similar bristles; inferior portion of the cheeks scarcely one-third of the longitudinal diameter of the eyes. Antennæ inserted a little above the median line of the eyes; basal joints short; second joint bristly on the upper part; third joint three times as long as the second; arista thickened on the proximal half. Proboscis black; palpi rufous, cylindrical, slightly thicker towards the end. Thorax cinereous, with four black stripes, of which the inner ones are indistinct beyond the transverse suture; the two outer stripes short and more spot like. Scutellum somewhat rufous, covered by a whitish grey dust; besides the marginal macrochætæ, the scutellum has two shorter discal ones. Abdomen ovate, cinereous; the first segment, the hind borders of the three following, and an indistinct dorsal stripe on the second segment, are black; the black hind borders occupy about one-fourth of the segments; the second and third segments are longer than the others, and have laterally a faint yellowish-red tinge. On the second segment there are two very short marginal macrochætæ, on the third a row of marginal macrochætæ, on the anal segment many hairs and bristles. Legs black; under-side of the front femora with a row of bristles; middle tibiæ with some long bristles halfway up their length; hind tibiæ externally fringe-like with bristles; tarsi shorter and thinner than the tibiæ; foot-claws and pulvilli short, the pulvilli yellowish. Tegulæ whitish. Wings nearly hyaline, slightly yellowish at the base; no costal spine; small cross-vein nearly on the middle of the discal cell; apical cell opened at a short distance before the wings tip; curvation of the fourth vein rectangular; apical cross-vein slightly concave: posterior cross-vein somewhat curved.

This fly was bred from the social casemaking caterpillar, *Cœnodomus hockingii*, Walsingham.

I have some doubt about the sex of the specimen; the absence of orbital bristles on the front seems to indicate that it is a male; the short

foot-claws and pulvilli on the contrary that it should be a female. I know another species from Java (*Crossocosmia curvipalpis*) which I intend to describe in Volume XXXVI of the Dutch "Tijdschrip voor Entomologie," and which shows the same combination of sexual characters. It stands in the nearest relation with the above described *Cr. biseriata*, but this latter differs from it in having a more prominent front, in the frontal bristles being more regularly arranged in a double row on each side, in narrower black hind borders of the abdominal segments, and in the apical cross-vein which is more concave.

3. *Tricholyga bombycis*, Becher.

Becher, Indian Museum Notes, I, p. 77, pl. V, fig. 1.

Of this Tachinid fly the Trustees of the Indian Museum at Calcutta have sent to me for examination two typical specimens, a male bred from *Attacus ricini*, Boisd., and a female, bred from the mulberry silkworm. Two other specimens (both females) in the same collection from Calcutta were not determinated, but proved to belong to the same species; they were indicated to be parasitic, the one on *Olene mendosa*, Hbn., the other on *Dasychira thwaitesii*, Moore.

Tr. bombycis seems to be a not uncommon insect in British India, as Becher has had several specimens of it. It also results from the foregoing remarks, that it attacks very different species of Bombycid Lepidoptera.

A species, which is said to be related to *Tr. bombycis*, deposits its eggs upon locusts (*Acridium peregrinum*, Oliv.): see *Indian Museum Notes*, IV, p. 33.

4. *Demoticus strigipennis*, n. sp. (♀).

Pl. I, fig. 2.

Black; head, sides of the thorax, and two girdles on the abdomen white; palpi rufous.

Length 7,5 millim.

Head hemispherical; front as broad as the thorax; frontal band black, as broad as the lateral portions of the front, which are silvery-white; frontal bristles strong, forming on each side a row, which descends to the end of the second antennal joint; two pairs of orbital bristles directed forward, and two pairs of bristles on the vertex, which are directed backward. Eyes bare. Face and cheeks silvery-white, without any pilosity, the face perpendicular; facial ridges nearly parallel; oral margin broad, not prominent; vibrissæ inserted a little above it and surmounted by a few short hairs; inferior portion of the cheeks a fourth

of the longitudinal diameter of the eyes; under-side of the head with a row of bristles. Antennæ black, inserted on the median line of the eyes; first joint short, second a little longer, third joint three times as long as the second; arista slightly pubescent, thickened at its proximal half. Proboscis black; palpi pale rufous, cylindrical. Thorax black; a white dust covers the shoulders, and is prolonged to a broad lateral band; a white median spot appears at the anterior margin; the hind margin of the thorax bears some long macrochætæ; scutellum black, laterally whitish, with long discal and marginal macrochætæ. Abdomen black, elliptical; the segments of nearly equal length; the front half of the second and third segments white, forming thus two white rings, which, however, are somewhat interrupted on the dorsal portion; first and second segments with a pair of marginal macrochætæ, the second also with a pair of discal ones, third and anal segments with two discal and a whole row of marginal macrochætæ; besides these macrochætæ still lateral ones; all the macrochætæ are long and strong; the anal segment is truncated, the short conical ovipositor rufous, at least towards the apex. Legs piceous-black, the front coxæ and the hind side of the front femora with whitish dust; the femora rather thick; the legs have long and scattered bristles; tarsi thin; foot-claws and pulvilli very short. Tegulæ bone-white. Wings slightly brownish, longer than the abdomen, their tip blunt and rounded; apical cell opened nearly at the wings' tip; curvation of the fourth vein rectangular without appendice; small cross-vein before the middle of the discal cell; apical cross-vein concave; posterior cross-vein distinctly curved; first and third veins bristly, the first nearly over its whole length, the third as far as the small cross-vein; the surface between the second and third veins shows a series of oblique folds, which appear as cross-veins if the wing is seen against the light.

A single female, bred in the Indian Museum from Lasiocampid caterpillars destructive to rice-plants in Sambalpur.

5. *Masicera castanea*, n. sp. (♂).

Pl. 1, fig. 3.

Blackish; head whitish; palpi, scutellum and sides of the abdomen rufous; antennæ and legs black.

Length 10,5 millim.

Head as broad as the thorax; front cinereous, on the vertex narrower than the eyes; frontal band more obscure but not black; frontal bristles on each side in a curved row, descending to beneath the second antennal joint; no orbital bristles. Eyes bare. Face whitish, perpendicular; facial ridges divergent downward and slightly bent inward near the

oral margin, which is not prominent; vibrissæ inserted immediately above that margin, and surmounted by three much smaller bristles; cheeks bare, their inferior portion no more than a fourth of the longitudinal diameter of the eyes; under-side of the head with a row of bristles; beard white; occiput grey. Antennæ inserted above the median line of the eyes; basal joints short; third joint four times as long as the second; arista thickened to beyond the half of its length; its basal joints inconspicuous. Proboscis black; palpi pale rufous, cylindrical. Thorax blackish cinereous, with indistinct black stripes; scutellum rufous. Abdomen elongate-oval, black, faintly cinereous at the front borders of the second and third segments, laterally with a large rufous spot, which occupies the second segment and the front half of the third; anal segment rufous, blackish at the base; second segment with two marginal macrochætæ; the third with a row of marginal macrochætæ; the anal segment with several macrochætæ and bristly hairs; under-side of the abdomen nearly wholly rufous and densely haired. Legs black; middle tibiæ furnished externally with three bristles, of which the most inferior is longer and stands on the middle, posteriorly, and a little lower down is another long bristle; hind tibiæ outwardly with a row of many bristles of various length. (The apical joints of all the tarsi are broken off: probably the foot-claws and pulvilli will be elongate.) Tegulæ yellowish-white. Wings greyish-hyaline; apical cell opened at some distance from the wings' tip; small cross-vein distinctly in front of the middle of the discal cell; curvation of the fourth vein rectangular, with a fold imitating a short appendice; apical cross-vein slightly concave; posterior cross-vein curved.

A single male specimen, bred from *Leucania extranea, Guen.*, which has proved destructive to crops in Patna.

6. *Masicera dasychiræ*, n. sp. (♀).

Pl. I, fig. 4.

Cinereous; head whitish; frontal band, antennæ, indistinct stripes on the thorax, first abdominal segment, hind borders of the following segments, and legs black; scutellum ochraceous; palpi rufous.

Length 7,5 millim.

Head broader than the thorax; front yellowish-grey, with parallel sides; frontal band black, narrower than the lateral portions; frontal bristles on each side in a curved row descending to the end of the second antennal joint; outside the rows of frontal bristles is a pair of orbital bristles; on the vertex two long bristles. Face white, perpendicular facial ridges slightly divergent towards the oral margin and immediately above it curved inward; vibrissæ inserted at this curva-

tion; a few fine hairs above them; cheeks without any pilosity, their inferior portion scarcely a fourth of the longitudinal diameter of the eyes; under-side of the head with a row of bristles; beard white; occiput grey; posterior orbits white. Eyes bare. Antennæ inserted above the median line of the eyes; basal joints short; third joint threeto four times as long as the second; arista thickened to beyond the half of its length. Proboscis blackish; palpi dark rufous, cylindrical, slightly thicker towards the end. Thorax blackish, cinereous; shoulders and pleuræ with grey portions; thoracic dorsum with indistinct black stripes; scutellum semi-circular, rufous, covered with grey dust and hence appearing ochraceous; its surface with short black hairs and its margin with several long macrochætæ. Abdomen ovate, cinereous; first segment black, the following segments with broad black hind-borders, second segment with two marginal macrochætæ, the third with a row of marginal macrochætæ; anal segment densely furnished with bristly hairs. Legs black; middle tibiæ with some long bristles and long spurs; hind tibiæ furnished externally with fringe-like bristles; foot-claws and pulvilli short. Tegulæ yellowish-white. Wings greyish-hyaline; apical cell opened at some distance before the tip of the wing; small cross-vein a little in front of the middle of the discal cell, curvation of the fourth vein rectangular without appendice; apical cross-vein very slightly concave; posterior cross-vein a little curved near its insertion in the fifth vein.

A single female specimen, bred from the caterpillar of *Dasychira thwaitesii*, Moore, which is injurious to the tea-plant.

7. *Masicera subnigra*, n. sp. (♀).

Pl. I, fig. 5.

Blackish-cinereous; face white with the oral margin rufous; thorax with black stripes; abdomen, antennæ and legs black; palpi rufous.

Length 9 millim.

Head as broad as the thorax; front and face broader than the eyes, with parallel sides; the front somewhat prominent, yellowish-cinereous with dark reflections; frontal band blackish, narrower than the lateral portions; frontal bristles strong, but not numerous, on each side in a curved row, descending to the end of the second antennal joint; outward of them a pair of orbital bristles directed forward; on the vertex two pairs of bristles directed backward. Eyes bare. Face and cheeks white, with some blackish reflections; oral margin somewhat rufous, not prominent; the face slightly inclined; facial ridges divergent downwards, but curved inwards before they reach the oral margin; vibrissæ inserted near that margin, surmounted by a few short bristly hairs;

under-side of the head rounded, with a row of bristles; inferior portion of the cheeks occupying a fourth of the longitudinal diameter of the eyes; occiput cinereous, densely furnished with yellowish hairs. Antennæ black, inserted above the median line of the eyes; first joint short, the second double as long as the first, the third scarcely three times as long as the second; arista bare, thickened in its proximal half. Palpi rufous. Thorax cinereous, with black stripes, which sometimes appear broader than the interstices, but in other lights appear as narrow black lines; scutellum cinereous, with the base black and with long discal and marginal macrochætæ. Abdomen elongate-oval, black, with the front margins of the second and following segments obscure cinereous; anal segment pointed; a pair of macrochætæ on the hind margin of the first and second segments, those of the second segment longer; a row of long marginal macrochætæ at the third segment; and many shorter macrochætæ on the whole surface of the anal segment.—Legs black; middle tibiæ furnished externally in the middle of their length with a long bristle, there are other bristles also below; hind tibiæ furnished externally with several scattered bristles; foot-claws and pulvilli short. Tegulæ white. Wings greyish-hyaline, slightly yellowish at the base; apical cell opened at some distance before the tip of the wing; small cross-vein before the middle of the discal cell; curvation of the fourth vein rectangular and with a fold imitating a short appendice; apical cross-vein distinctly concave; posterior cross-vein curved.

A single female specimen, bred from *Olene mendosa*, Hbn.

This fly has much resemblance to *Tricholyga bombycis*, Becher, but differs in the bare eyes, in the broad stripes, on the thorax, and in the less numerous and more scattered bristles on the outside of the hind tibiæ.

8. *Miltogramma duodecimpunctata*, n. sp. (♂).

Pl. I, fig. 6.

Cinereous; abdomen with three blackish spots on each segment; leg blackish; antennæ and palpi rufous.

Length 7, 5 millim.

Head grey; the cheeks and orbits with white reflections; front narrower than the eyes; frontal band cinereous, on each side with a row of short frontal bristles which descend to the end of the first antennal joint; no orbital bristles. Eyes bare. Face perpendicular; facial ridges firstly divergent, but inferiorly curved inward; vibrissæ inserted justly at the oral margin; cheeks broad, convex, their inferior portion short-haired, occupying at least one-third of the longitudinal diameter of the

eyes; under-side of the head long, with a row of rather short bristles. Antennæ inserted above the median line of the eyes, rufous, with the tip of the third joint brown; basal joints short; third joint two and a half times as long as the second, but reaching no lower than the half of the face's length; arista black, thickened and microscopically pubescent at its proximal half. Proboscis black; palpi rufous, cylindrical, black-haired. Thorax and scutellum greyish-cinereous; thoracic dorsum indistinctly with several blackish stripes. Abdomen conical, yellowish-cinereous, laterally slightly rufous; first segment shorter than the following segments, which are nearly of equal length; anal segment and especially the anus with a yellow tinge; hypopygium yellowish-rufous, turned downwards to the venter; each of the segments with three blackish-brown spots, the median ones larger; first and second segments without macrochætæ; third segment with a pair of short macrochætæ; anal segment with several discal and marginal ones. Legs blackish; coxæ and femora cinereous; the femora broad; foot-claws and pulvilli slightly elongated, the claws black, the pulvilli yellowish. Tegulæ white. Wings greyish-hyaline, with a small costal spine; apical cell opened before the wings' tip; small cross-vein on the middle of the discal cell; curvation of the fourth vein with an acute angle and a distinct appendice; apical cross-vein very concave near its insertion in the fourth vein; posterior cross-vein straight.

A single male specimen, sent to the Indian Museum at Calcutta as a parasite of *Acridium peregrinum,* Oliv. Its origin from this Orthopterous insect, however, is somewhat doubtful, as it was not actually bred in the Museum; but in view of the occurrence of another Tachinid fly, living parasitically on locusts (see *Indian Museum Notes,* Volume III, p. 33), it may be admitted that the above described species indeed attacks orthoptera.

9. *Calodexia lasiocampæ,* n. sp. (♂).

Pl. I, fig. 7.

Thorax and scutellum grey, the thorax with black stripes; head whitish; abdomen yellow; antennæ, legs, an interrupted dorsal band on the abdomen, and the anal segment, black; palpi rufous.

Length 8 millim.

Head semi-globular, when seen from before nearly as high as broad; front whitish-grey, arcuated, narrowed behind, on the vertex half as broad as the eyes; frontal band black, forming a long triangle with the tip towards the vertex; frontal bristles in a row on each side of the frontal band, and descending to the base of the antennæ; on the vertex two

pairs of bristles directed backward, and two ocellar bristles directed forward; behind these a bundle of long hairs. Face and cheeks grey with white reflections; the face not carinated, the cheeks narrow; the lower portion of the latter no more than a sixth part of the longitudinal diameter of the eyes; facial ridges rather sharp, gradually divergent till at some distance of the oral margin, where they become less distinct and are somewhat curved inward; vibrissæ inserted at the oral margin, which is not at all prominent; under-side of the head with a row of bristles; occiput grey, the broad posterior orbits white. Eyes bare. Antennæ inserted on the median line of the eyes; first joint short; second twice as long as the first, with one or two short bristles; third joint linear, one and a half time as long as the second, and reaching to about the middle of the face; arista shortly plumose. Proboscis black; palpi rufous, slender. Thorax grey; thoracic dorsum cinereous, with four black stripes, the two median linear; pleuræ with white reflections; scutellum cinereous, blackish at the base. Abdomen elliptical, rufous-yellow, slightly transparent; on the first three segments a black dorsal band, which is interrupted at the front borders of the second and third segments, and enlarged at the hind border of the third; the anal segment is black with lateral spots of white reflection; similar spots are also to be seen on the sides of the preceding segment; the second segment is longer than the others; on the first segment is a pair of marginal macrochætæ, on the second a pair of discal and a pair of marginal macrochætæ, on the third a pair of discal and a row of marginal macrochætæ; the anal segment bears many macrochætæ. Legs black, slender, the tarsi longer than the tibiæ outwardly with bristles of unequal length; foot-claws and pulvilli elongate, the pulvilli yellowish. Tegulæ pale yellow. Wings longer than the abdomen, grey at the base and along the costa yellowish; apical cell opened just before the tip of the wing; third vein nearly straight; small cross-vein in the middle of the discal cell; curvation of the fourth vein rectangular; apical cross-vein concave; posterior cross-vein distinctly curved.

A single male specimen, bred from a Lasiocampid caterpillar, which is destructive to paddy in Sambalpur.

The generic characters of the Mexican genus *Calodexia*, V. d. W. (see Biologia Centr. Americana, Diptera, Volume II, p. 257) are in general applicable to this fly; it differs only from the three described Mexican species, in having the second antennal joint longer and the third joint shorter.

NOTES ON A NEW PSYLLID.(1)

BY G. B. BUCKTON, F.R.S.

Dr. Fraz Löw in his Katalog der Psylloden, Wien., 1882, describes the European forms under four sub-families (*viz.*), Liviinæ, Aphalarinæ, Psyllinæ and Triozinæ. The Psyllinæ are characterized by a distinct stigma on the costa of the hemelytron, with a straight cubitus and furcated sub-cubital and sub-marginal veins.

The Triozinæ want the stigma and as a rule show the sub-cubital vein coterminous with the basal cubitus.

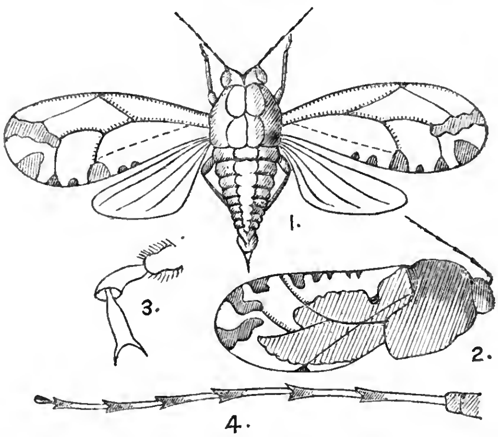
The Psyllidæ of Asia have as yet had but little attention bestowed upon them ; and I am not aware of the existence of any descriptive catalogue which can give much help as to identification of Eastern forms.

Some twenty or more specimens taken at Poona in the Bombay Presidency, India, have been submitted to me, on which I offer the following notes.

The winged form only has come under my notice, but nevertheless sufficient variations from any of genera erected by Dr. Löw seem to justify a new genus at least, and if future observation should bring to light other similar species, possibly it might be well to increase the number of the sub-families.

From the somewhat trivial characters of blotchings on the wing-membranes, and the stippled or spotted condition of the nervures, I propose the names for this insect which provisionally may be accepted as typical.

Phacopteron(2) *lentiginosum*, n. sp.



(1) The specimens upon which this paper is founded were forwarded to the Museum in July 1893 from Poona, where they were found in galls on *Garuga pinnata*, Roxb.—*Ed.*

(2) From φακος = spotted.

General colour pale ochreous. Abdomen and legs piceous brown. Vertex much narrower than the pronotum. Eyes moderately large. Antenna about equal in length to the head and pronotum together. Articulations nine (?), the two basal joints globose, the third the longest of all, the terminal joint nodular.

Notum and pronotum separated by a suture, tumose, and much overhanging the abdomen. This last organ is fusiform, pointed, terminated in the male by a rounded pygofer without upright appendages, and in the female by a linear ovipositor.

Hemelytron with a nearly straight basal cubitus, which ends in a rounded stigma on the costa, the cubitus then passes by nearly a right angle towards the margin, but unlike Psylla proper, it furcates before it reaches the same. The sub-cubitus starts direct from the basal cubital vein and not from the marginal. It furcates and forms the sub-cubital cell.

The sub-marginal vein and its cell is absent. The wings (lower) are very delicate and have three simple veins.

The membranes of the elytra are pearly-white, ornamented with three larger and several smaller brown patches, through which the nervures (which are raised and marked with dark spots as we see in the cixiike Tettigidæ) pass. Legs are hirsute stout, and furnished with two tarsal joints and two claws. Rostrum very short, pointed, and it appears to rise from between the second coxæ.

It will be seen that the above diagnosis does not well accord with any genus given by Dr. F. Löw either in Beeträge Zur Kenntniss der Psylloden or in his Katalog, but future observation may make the above observations more complete, through a study of the immature larval forms.

Expanse of wings 0·40 of inch.
Length of body 0·16 „ „

The specimens at my disposal were mildewed from damp, but it is possible that when alive the insect may have shown a slight cotton-like investment.

Description of Plate.

Fig. 1.—The winged female.

Fig. 2.—Insect seen in profile, showing the over-hanging pronotum.

Fig. 3.—Tarsal joints and claws.

Fig. 4.—Antenna.

THE BANDED MOSQUITO OF BENGAL.

BY F. A. A. SKUSE, ENTOMOLOGIST TO THE AUSTRALIAN MUSEUM, SYDNEY.

Culex albopictus, Skuse, Sp. nov.

Female.—Length of antennæ 1·50 mm.; expanse of wings 2·50 × 0·50 mm.; length of body 3-3·50 mm.

Black with silvery-white markings. Antennæ somewhat shorter than the proboscis, joints of the scapus with silvery scales. Head with silvery-white scales on the front and sides. Proboscis five times the length of the palpi, the latter tipped with silvery scales. Thorax traversed by a line of silvery scales for rather more than its anterior half; pleuræ spotted with silvery white; scutellum with minute silvery hairs. Abdomen twice the length of the thorax, the segments bordered with a narrow band of silvery scales, and with lateral silvery spots. Legs: femora with a silvery line beneath and slightly tipped with silvery scales; tarsi, the first two joints in the fore and intermediate legs with a narrow silvery-white ring at the base; broad rings at the base of all the joints of the tarsi in the hind legs, the last joint entirely white. In the hind-legs the tibia about one-third longer than the metatarsus. Wings the length of the abdomen, pellucid, iridescent, the veins clothed with linear black scales. Auxiliary vein joining the costa at a point a little before the posterior branch of the fifth longitudinal vein; middle cross-vein indistinct, shorter than the posterior cross-vein, situated beyond it scarcely a distance equal to twice the length of the latter; first sub-marginal cell longer and narrower than the second posterior cell, their bases opposite or almost opposite; anterior branch of the fifth longitudinal vein originating about midway between the origin of the second longitudinal vein and the tip of the sixth longitudinal.

Hab.—Bengal.

Type in Australian Museum.

Three specimens received from Mr. E. C. Cotes, who informs me that this insect is a great nuisance in Calcutta. The species is allied to *C. nostoscriptus*, Sk., from New South Wales, and *C. bancrofti*, Sk., from Queensland, but the silvery ornamentation of the thorax in these latter is of an elaborate pattern (Proc. Linn. Soc. N. S. W., Vol. III (Ser. 2), 1888, pp. 1738, 1740).

SCALE INSECTS IN MADRAS.

BY R. NEWSTEAD, F.E.S., CURATOR OF THE GROSVENOR MUSEUM, CHESTER, ENGLAND.

(*With two plates.*)

All the insects described in this paper were collected by Miss. L. E. Tomlin, Chester, England, during her visit to Madras, 1892-93. At least two of the species are of economic importance, viz., *Icerya ægyptiacum*, Doug., and *Dactylopius ceriferus*, n. sp., the rest do not appear to be injurious, but they may at any time present themselves as such, therefore it is as well to publish what is known of them at once. The discovery of the male of *Ceroplastes ceriferus*, Anderson, is of great interest and scientific value, and I have much pleasure in appending the description and figures.

It must also be added that Miss Tomlin made careful coloured drawings from life of all the insects; these have been very helpful to me in the preparation of my descriptions. Some of the figures have been reproduced on the plates, and are gratefully acknowledged.

For the names of the food-plants, so far as it was possible to obtain them from the inadequate material available, I am considerably indebted to Prof. Oliver, Kew, England.

"THE INDIAN WHITE WAX INSECT."

Ceroplastes ceriferus, Anderson.—Plate II, Fig. 1.

In this publication (Volume II, pp. 91-97) Mr. E. C. Cotes has given a most interesting account of the female of this species, and the uses of its white wax. So far, however, no one has given any detailed description of the female and nothing has hitherto been ascertained as to the transformations of the insect. Miss Tomlin, however, was fortunate in obtaining many examples in various stages, from a low bushy shrub (*Asclepiadrom*), growing in sandy soil at seven Pagodas, Madras, in February 1893, which were carefully packed and forwarded to me. There were many examples of the adult female on the stems of the food-plant, with their thick, irregular coverings of white wax, but there were neither eggs nor larvæ in them; judging from the colour and condition of the wax, I should say that the females had been dead some time, and this is what one would expect as the young females were when taken at the period of fecundation. On the leaves, and more rarely on the stems, were numerous examples of the young females (second stage), and scales of the male, all of the latter were apparently empty. On looking carefully over the *debris* at the bottom of the packet, I found

many examples of the perfect male which delighted me, for hitherto not a single male of any of the known species of the genus *Ceroplastes* has been discovered. Undoubtedly the males must have hatched during transit, and it is well that Miss Tomlin collected them when she did, or we should have had but their empty scales to tell that they had existed.

Below I append a description of the different stages :— ♀ Adult (fig. 1*a*), gives off a rich reddish-brown, or purple-brown stain in caustic potash; covered with a thick layer of dirty yellowish white wax, of a more or less hemispherical form, often cracked and irregular in outline, and apparently varying according to the age of the individual. Body (fig. 1*b*.) denuded of the wax, elongate ovate, shining reddish brown, with a blunt horn-like prominence at the abdominal extremity, at the apex of which are the true candal scales; surface with fine punctures arranged wide apart. Dermis when viewed from *above* with a transmitted light, faintly tessellated in portions only (fig. 1*c*.), in the centre of each tesselłæ an elongated pore, or spinneret of the shape shown at fig. 1*d*.; these latter are always present in all parts of the dorsal dermis, but to be seen as shown in the fig. 1*d*., they must be viewed from above and they are not clearly defined in all cases. On the margins near the spiracles are numerous short conical spines. Antennæ (fig. 1*e*.) of 6 joints, of which the 3rd is longest, and forms more than one-third of the antenna; 4th as long as the 5th and 6th together; 5th shortest; three last with deeply gradated sides. Legs (fig. 1*f*.) with the coxæ large, trochanter with a long hair; tarsi a little shorter than the tibiæ, with two short slender digitules, those of the claw uneven, *i.e.*, one much larger than the other: both dilated at base and extremity.

Long with waxy covering 3½-8 mm., wide 3-6 mm., high 2·5 mm.

Long without waxy covering 5 mm., wide 2½ mm., high 2½ mm.

The latter is the measurement of a single ♀ only.

In the Gardener's Chronicle, 1853, page 484, Professor Westwood figures the adult female, and I may say that the illustrations agree with several specimens taken by Miss Tomlin. The description of the female, however, is very poor, and without the illustrations would be useless.

♀ Young (fig. 1*g*.), dorsum evenly covered with a layer of pure white wax; margin all round with broad, lateral, projecting plates of the same material; and there are two small ones placed close together over the anal orifice. In this stage the insect is very pretty, and forms a very interesting microscopic object. Long ½-1 mm.

♂ (Fig. 1*h*.) Reddish brown (restored specimens), body rather short, wide; eyes black, large and prominent; the two ocelli beneath small; antennæ of 10 joints (fig. 1*k*.), 3rd longest, all with many long fine hairs, and deeply notched sides. Legs (fig. 1*l*.) ordinary.

Wings rather short. Genital armature (fig. 1*m*.) somewhat triangular with a large, thin, projecting funnel-shaped organ. Anal lobes each with one very long hair, and one or more short ones; lobes with numerous circular discs. The long anal setæ in life would no doubt be covered with white wax forming long white filaments, common in all the males belonging to this division of the Coccidæ. In all the specimens examined the white covering was wanting and no doubt was broken away during transit.

Scale of the ♂ (fig. 1*n*.) opaque glassy white, with a broad central and three lateral carinæ, the central ones meeting form a complete loop.

Long 2-2½ mm.

The form of the genital armature of the ♂ is unique, and may be of generic importance. In other respects the ♂ does not differ from the ♂ of the genus *Lecanium*, and the scale of the ♂ is also very like those of the latter, but there is no central "coronet" or ring.

So far then we have the description of the species in nearly all stages, but there is yet much to learn of its habits. I have no hesitation in saying that it would not be a difficult matter to work out the life-history, but rather a pleasant task for some resident Entomologist, and it would add much to our knowledge of these minute beings.

P.S.—Since completing the above description Mr. Maskell of New Zealand has sent me his paper on Coccidæ for 1892 (Trans. N. Z. Int., Vol. XXV) in which the author has described and figured the female of the above species. Mr. Maskell's figure of the female of the second stage is, however, very different to mine, but this must be due to the age of the insects; probably his examples were much older than mine, which will account for the discrepancy as to the arrangement of the waxy covering.

Pulvinaria obscura, n. sp.

Pl. III, Fig. 3.

♀ At period of fecundation (fig. 3*a*.) yellowish brown, short ovate, narrowed in front, with a central carina extending from the anal dorsal scales to anterior margin, or nearly so. Segmentation more or less distinct; after egg-laying the body becomes tilted, and contorted, as is usual with the ♀ of this genus. Antenna (fig. 3*b*.) of 8 joints, of which 2 and 3 are longest, and in length nearly equal; 4, 5, and 8 shorter, 6 and 7 shortest and equal. Could only find hairs on the fifth and eighth. Legs apparently ordinary, but could not be plainly traced. Rostral filaments unexpanded, about half the length of the antenna Anal dorsal scales long, each with two small dentations on outer margin. Long 2½-3 mm., wide 2 mm.

Ovisac long, narrow, composed of the ordinary close white cottony material. Long 5-7 mm., wide 2 mm.

Larva normal, with 3rd joint of antenna longest; anal emargination wide.

All the females seen were located behind the whorls of flowers of the food-plant; none were found in exposed situations; in order to see them it was necessary to remove the flowers, etc., from the stem, but on doing this the sacs were much broken, and it was difficult to obtain perfect examples.

Hab.—On *Hygrophila spinosa* at Nungumbaukum, Madras. March 14th, 1893.

Described from several females and one perfect sac. ♂ unknown.

Dactylopius ceriferus, n. sp.

Pl. III, fig. 2.

♀ Adult immediately prior to gestation (fig. 2, *a.* & *b.*), elongate ovate, narrowed behind from the thoracic segment; beneath olivaceous, above paler, with the black viscera, etc., showing through the dermis; there are two very long white filaments at the anal extremity, but marginal plates are entirely wanting; radiating from all parts of the body above are numerous very long, delicate, waxy filaments; these latter in the more advanced stage, and when egg-laying has taken place, become very dense, and matted below, completely covering the insect; projecting from the thick matted mass, are very numerous, and exceedingly long, delicate filaments, varying in length from 5 to 10 mm.; these superficially have much the appearance of sponge spicules, as many are perfectly straight and cross each other in all directions; all the specimens received were aggregated together in masses completely covering the under sides of the leaves (fig. 2*c.*). Antenna (fig. 2*d.*) of 8 joints, of which 3 and 8 are equal and longest, 2 shorter, 4 to 7 shortest and equal: all with fine hairs. Legs long, hairy; hairs at apex longest; tarsi a little less than one-third the length of the tibiæ; the latter with a short spine at apex; digitules of tarsi slender, those of the claw stouter and much dilated at extremity (fig. 2*e.*). Rostrum biarticulate with many long hairs; unexpanded filaments about three times the length of the rostrum, not quite reaching the insertion of the intermediate legs. Anal ring with 6 short hairs, intervening spaces with clear circular spaces, or slightly raised discs. Anal lobes normal, each with a very long hair, and two or three strong spines. Dermis: ventral surface between antennæ in front with numerous long hairs and clear circular spaces, or spinneretts, surrounded with from 3 to 5 hairs, these occur

again near the oval lobes ; the rest of the dermis with a few scattered hairs. Long 3-3½ mm., wide 2-2½ mm.

♀ Second stage (described from Miss Tomlin's coloured drawings) very elongate, ends equally rounded, ochreous, dorsum darker; legs reddish. Caudal filaments long, those of the body long, slender, and straight.

Hab.—On croton at Nungumbaukum, Madras, Jan. 10th, 1893. This very interesting species is allied to the *D. filamentosus* of Cockerell, Jour. Inst., Jamaica, Vol. I, page 254, but this latter has a seven-jointed antenna. I know of no species of Dactylopius secreting such a quantity of waxy material as this, and the species appear in other respects to be quite distinct and I venture to describe it as new. It is a most injurious species infesting crotons in the compound. In her notes Miss Tomlin says :—"Also found on leaves of trees, but not so plentiful there." Whether these are the same as those which occur on the croton I am unable to state as the specimens were not forwarded for investigation.

Dactylopius viridis, n. sp.

Pl. III, fig. 1.

♀ Adult prior to gestation (fig. 1*a.*) covered with white mealy wax, margin all round thickly set with narrow white waxy appendages, except at anal extremity where there is a slight division ; in the more advanced stage the insect covers its body with a thick layer of white waxy felting which forms a complete oval sac in which the eggs are laid. When treated with potash it is of a beautiful emerald green, which is retained to a certain extent after mounting in Canada Balsam. Antenna (fig. 1*b.*) short of 7 joints, last joint the longest, and in length equal to 2 and 3 together ; the rest are of nearly equal length : all with very fine short hairs ; Legs (fig. 1*c.*) short, very little longer than antenna ; tarsi much shorter than tibiæ; digitules of claw and tarsus slender : all are often wanting. Rostrum biarticulate, basal joint with two stiff hairs at apex, and two more on the middle of the apical joint. Anal ring with six hairs. Anal lobes obsolete with one long hair : often broken away, and two or three short spines. Dermis with a few short delicate spines, more numerous beneath in front near the antennæ.

♀ Long 2-3 mm., wide 1-1½ mm., Sac long 3½ mm.

Larva, anal lobes nearly obsolete, each with one long and two or more short hairs. Antenna of 6 joints, 1 to 5 short and sub-equal, 6 about one-third the length of the whole. Anal ring with 6 hairs. Rostrum biarticulate, filaments very long.

Hab.—On *Hygrophlia spinosa* at Madras, collected March 14th. All the specimens received were located and partly hidden in the whorls of the spines, leaves, and flowers of the food-plant. Quite fifty per cent. of the specimens were infested with a large dipteron, and some small Hymenopterous insects.

In its green colour it is like *Dactylopius virgatus,* Cockerell, M. S., but this has an eight-jointed antenna, and the "tibia about three times as long as the tarsus" (in lit.).

Two specimens of what I take to be mere varietal forms of the above were found on *Pithecolobium dulce.* Externally they differ materially, as are shown at pl. iii, fig. 1*d*., female's nat. size, and at fig. 1*e*., the same magnified; structurally, however, they do not appreciably differ, and I hesitate in describing them as new with the limited material at hand.

Aspidiotus orientalis, n. sp.

Pl. III, fig. 4.

♀ Scale (figs. 4*a*., 4*b*.) circular, or nearly so, but varying according to position on the food-plant; brownish yellow, or straw colour, sometimes tinged with reddish-pink; exuviæ a little to one side, covered with a nipple-like prominence which is darker than the rest; following this are three concentric circular depressions: the first small and near the "nipple," second well defined and about midway between the two, third often wanting, or but slightly indicated; margin much interrupted and paler than the rest. Diam. 1-1½ mm.

♀ Adult widely ovate (fig. 4*c*), almost circular; last segment (fig. 4*d*., 4*e*.) with three pairs of well-defined lobes: 1st and 2nd each with a deep equal notch at apex on each side; 3rd smallest, narrow, and notched at apex on the anterior margin only: posterior margin straight; between each lobe are two slender plates, and immediately preceding the 3rd lobe there are three; there is a single spine on the dorsal surface immediately over the 3rd plate, and one or more on the margin at the base.

There are four groups of spinnerets: the anterior laterals consist of 5, the posterior laterals of from 3 to 5: usually 5; the anterior group is represented by a single spinneret: no trace of more in any of the many examples examined. There are also very numerous elongated and ovate pores arranged as shown in fig. 4*d*. The plates are very difficult to trace, but the lobes are very distinct.

♂ Scale (fig. 4*b*.) similar to that of the ♀ but smaller.

♂ Unknown.

Hab.—Seven Pagodas, Madras. Name of the food-plant unknown, but evidently a species of Panicum, or grass. The scales were frequently aggregated together behind the leaf-sheaths, and could only be seen on removing the latter.

THE "EGYPTIAN COTTONY CUSHION SCALE."

Icerya ægyptiacum.

Pl. II, fig. 2.

Crossotosoma ægyptiacum, Douglas. Ent. M. M. S. S., Vol. I, p. 79.
Icerya ægyptiacum, Riley. Insect Life, Vol. III, p. 97.

Hitherto this most destructive pest was only known to occur at Alexandria, Egypt, where it has for the last eight years caused the greatest alarm.

In a letter dated September 10th, 1892, Rear Admiral R. W. Blomfield, R. N., writes of this pest as "an eleventh Egyptian plague, which made its appearance at Alexandria in 1885, and has since proved most destructive to all kinds of vegetation. Origin unknown." (In lit.)

It was unknown to naturalists until the year 1890 when Mr. J. W. Douglas of Lewisham, England, described it for the first time as *Crossotosoma, N. G., ægyptiacum*, n. sp. (l. c.). The specimens from which Mr. Douglas made his descriptions, were "received from Mr. D. Morris, Assistant Director of the Royal Gardens, Kew, to whom they had been sent from Alexandria, Egypt, where they were causing immense injury to fruit trees" (Doug. l. c.).

Later Dr. C. V. Riley (l. c.) refers the species to the genus *Icerya*, to which it undoubtedly belongs. Several other interesting accounts of this pest are given by Dr. Riley in "Insect Life," and as they may not be accessible to the general public, I venture to quote some of them. At Vol. II, p. 256, is the first record, as follows:—"During the past four years the gardens in Alexandria have been infested by a coccus which destroys all of the trees, and is causing the greatest alarm. . . . . Admiral Blomfield[1] noticed it in quantities on the under-side of the leaves of the Banyan tree, but it soon spread with extraordinary rapidity, and some of the most beautiful gardens of the city full of tropical trees and shrubs have been also destroyed. A breeze sends the cottony pest down in showers in all directions. It seems to attack almost any plant, but the leaves of *Ficus ruginosa* and one or two other kinds of fig seem too tough for it, and it will not touch them. He states that it seems

[1] Spelt in error Blunfield.

almost impossible for a few Horticulturists to try to eradicate the pest while their indifferent neighbours are harbouring hot beds of them, and there will have to be some strong measures taken by law to put it down." Referring to the statement that "a breeze sends the cottony pest down in all directions," it is evident that it is the white waxy appendages that are blown about, and not the insects themselves; so fragile are the former that it is difficult to obtain perfect examples of the insects.

Again Dr. Riley writes (Vol. III. p. 423). Through the kindness of Mr. Louis B. Grant, Acting Consul-General at Cairo, and of the Department of State, this Department has received copies of publications from Alexandria and Cairo, from which it seems that the insect is even more injurious than our previous information, through Mr. D. Morris, led us to suppose. It is by no means confined to fig trees, but has attacked oranges and lemons. Dr. Riley then suggests the collecting of the white wax, which he says "is absolutely pure and, we should say, of equal quality with the white Chinese wax secreted by *Ericerus Pé-la*, having the advantage of not being mixed with the bodies of the insects."

Miss Tomlin found all her specimens on the under-sides of the leaves of a purple-leaved plant very like a coleus, in the compound at Nungumbaukum, Madras, December 13th, 1892, where it was very abundant but local. All the specimens Miss Tomlin forwarded to me were immature females, except two or three which had partly formed their ovisacs, but there were no eggs in them. Lying alongside the females, were numerous examples of the male sacs, but I failed to find a trace of the perfect insect amongst them; all had undoubtedly hatched some time before the sacs were collected, which is unfortunate as the male of this species is unknown, and its discovery would be of great interest and value.

Fortunately I had specimens of the females from Egypt in all stages, and was therefore able to compare them with the Indian specimens, which I did and found them to agree in every particular with the immature examples : both as to the arrangement of the waxy plates and structurally. Below I append a description of the second stage, female and male sac, which has not hitherto been described.

♀ Second stage (fig. II, 2*a*.; 2*b*. 2*d*.) bright orange, but only seen on the under-side, or in other parts when denuded of the waxy covering. Dorsum in perfect specimens covered with pure white, conglomerate, waxen plates, irregular in shape; margin all round with long narrow curly plates. Fig. 2*a*. represents the insect's natural size on leaves of the food-plant; fig. 2*b*., 2*d*. the same magnified. Dorsal and ventral view, with the appendages more or less imperfect; fig. 2*c*. dorsal view of perfect specimen; all of the same age. The antennæ vary in the

number of joints according to the age of the individual; generally, however, there are eight joints, but some have seven and others nine joints; the rest of the characters do not appreciably differ from the adult female. Long 3-7 mm., wide 2½-6 mm. including filaments.

♂ Sac elongate, composed of a rather close white waxy felting. Long 2½-3 mm. Specimens much broken, therefore the measurements may not be quite correct.

The adult female is very similar to that of the second stage, but is much larger, has the marginal appendages much longer, and a large projecting bag or sac attached to the abdominal segments in which the eggs are laid.

Parasites.

The first consignment of coccids reached me on February 20th; in the packet containing the Iceryas were a number of what I took to be chalcid parasites; thinking that they might be of economic importance, I forwarded specimens to Dr. C. V. Riley of the United States Department of Agriculture, Washington, who very kindly replied as follows:—"The fact of the occurrence of *Icerya ægyptiacum* in India is very interesting and important, and the parasites were examined with bated breath. Most unfortunately, however, instead of being primary parasites, they are secondary, and the whole series belongs to an apparently undescribed species of *Tetrastichus*, all of the species of which are hyper parasites so far as I know." (In lit. Ap. 20, 93.)

Miss Tomlin has now returned to England, and I fear there is little chance of obtaining the true parasite: unless some competent Entomologist visited the locality early in December, when it ought not to be a difficult matter to work the whole subject out, and to breed out the true parasite. Judging from the number of sub-parasites, which undoubtedly hatched during transit, the true parasite must be very numerous.

Remedies.

I am not in position to judge what is best as an application to the *Icerya* should it be found injurious, but no doubt the same application recommended for *Icerya purchasi*, Mask., would be effectual in destroying this pest. (See *Insect Life*, Vol. II.)

The most successful remedy adopted in America against the *Icerya purchasi* has been the introduction of an Australian "Lady-bird" beetle (*Vedalia cardinalis*), where it has cleared thousands of orange trees of the destructive coccids. This *Vedalia* has also been imported into Alexandria by Dr. Riley for the destruction of the Egyptian *Icerya*, where they have done excellent work. Admiral Blomfield, who had

the management of the *Vedalias,* told me that it was wonderful to see how soon these small beetles cleared off the *Iceryas,* but I believe they are but a small colony at present. It is hoped, however, as they increase the *Iceryas* will diminish.

The following are some interesting letters addressed to Mr. Coquillett at Los Angeles upon the subject of *Vedalia* beetles. They are quoted from *Insect Life,* Vol. II, p. 190 :—

"* * * The *Vedalias* that you brought to my place about the 20th of last March, and which we colonized on four large orange trees that were covered with Fluted Scale, have spread in all directions, although to begin with they followed the direction of the wind most readily. From those four trees they have multiplied so rapidly that in my orchard of 3,000 trees it is seldom that we can now find a Fluted Scale ; I find a few of them on some weeds in spots, but I can also find the beetles there. The trees have put on a new growth and look altogether different; even the black fungus on the old leaves has loosened its hold and begins to fall to the ground. Besides having cleaned my orchard, they spread also to the orchard of my cousin and to my father's orchard ; the latter was also re-enforced by colonies from Mr. J. W. Wolfskill and from Colonel J. R. Dobbins. As my father has some 10,000 trees, and mostly all were more or less infested, the *Vedalias* had a grand feast ahead of them, and they have done their work most wonderfully. What I have said of my orchard applies to my father's also, and really to all our neighbours. When the *Vedalias* first began to multiply we took colonies of fifty or more in the pupa state and placed them in different portions of the orchard, and even had we not done so the *Vedalia* unaided would itself have reached there in almost the same time.

"On the Chapman place the *Vedalias* have cleaned the Fluted Scales off of the 150 acres of land. They have taken more than an oppressive burden off of the orange grower's hands, and I for one very much thank the Division of Entomology for the *Vedalia cardinalis,* the insect that has worked a miracle.—[A. Scott Chapman, San Gabriel, Cal., October 18, 1889.]

"* * * The *Vedalia* had practically freed my orchard of *Iceryas* on the 31st of July. It was on that date that I was obliged to post a notice at the entrance to my place, saying that I had no more *Vedalias* for distribution. The scale and lady-bird had fought out the battle, and while the carcasses of the vanquished were everywhere present to tell of the slaughter, the victors had disappeared almost entirely from the field. I have 35 acres in orchard, some 3,200 trees in all. I never colonized any *Vedalias* in my grove, excepting the two consignments which you brought to me yourself, one box on February 22nd and two boxes March 20. I noticed the first increase from the lot No. 1 on the 15th April, and from lot No. 2 on the 24th of the same month. On the 25th of April I found larvæ upon several adjacent trees. These facts are from memoranda made at the time. I have a list of the names of fruit growers, 226 in number, to whom I personally distributed over 120,000 *Vedalias* in colonies of various sizes between May 31st and July 31st. * * * [J. R. Dobbins, San Gabriel, Cal., October 22, 1889.]

"I am glad to report that the lady-birds you sent me are doing good work and increasing in this neighbourhood, and as soon as all are supplied, I will establish some on the mountain where the brush is full of them, also a small patch near the Ocean, and hope the Cottony Cushion Scale will soon be a scarce article in this section.—[Joseph Sexton, Goleta, Cal., August 12, 1889.]"

As it is of the greatest importance that this pest should not spread to cultivated crops, I would recommend the destroying of all the infested plants by burning. From what I can gather the food-plant at present known is but a weed, so there need be no compunction about the matter. December would be the best month for destroying the pest, as they will not then have laid their eggs.

Below is a list of other species sent:—

Lecanium hemisphericum—On leaves and stems of a climbing rose, in the Nilgiri Hills.

Lecanium sp.?—Scales of the ♂, and perfect ♂; food-plant not identified. In absence of the ♀ I do not think it wise to describe the species, which is probably new.

? Chionaspis—On rose leaves. Scales of the ♂ only. Nungumbaukum, Madras.

Aleyrodes sp.—On a low creeping plant, very like our British "Bindweed" (Convolvulus). Insects in all stages. The white wings of the imagines are spotted with black.

Aleyrodes sp.—On same plant as *Aspidiotus orientale*, and same locality. The pupa is rather large and black; dorsum and margin with very long white waxy fringe; that on the dorsum erect, and matted together, forming a large mass, but does not completely cover it.

Description of figures.

Plate II, fig. 1, *Ceroplastes ceriferus*; (*a*) adult females, natural size, on food-plant; (*b*) female with waxy covering removed; (*c*) portion of dermis magnified; (*d*) spinneret or gland magnified; (*e*) antenna magnified; (*f*) leg magnified; (*g*) young female magnified; (*h*) male magnified; (*k*) antenna of male magnified; (*l*) leg of male magnified; (*m*) genitalia of male magnified; (*n*) male scale magnified.

Plate II, fig. 2, *Icerya ægyptiacum*; (*a*) young females, natural size on under-surface of leaf; (*b*) and (*c*) the same, dorsal view, magnified; (*d*) the same, ventral view, magnified.

Plate III, fig. 1, *Dactylopius viridis*; (*a*) adult females magnified; (*b*) antenna of same magnified; (*c*) leg of same magnified; (*d*) females, natural size, on food-plant; (*e*) the same magnified.

Plate III, fig. 2, *Dactylopius ceriferus*; (*a*) female, dorsal view magnified; (*b*) the same, ventral view, magnified; (*c*) the same, covered with filaments on a croton leaf, natural size; (*d*) antenna magnified; (*e*) foot magnified.

Plate III, fig. 3, *Pulvinaria obscura ;* (*a*) adult female on portion of food-plant magnified ; (*b*) antenna of same still further enlarged.

Plate III, fig. 4, *Aspidiotus orientalis ;* (*a*) female scales, natural size, on food-plant; (*b*) females and males, dorsal view, magnified; (*c*) female, ventral view, magnified ; (*d*) posterior segment of same further magnified; (*e*) fringe of same yet more enlarged.

NOTES ON THE OVIPOSITION OF HELOPELTIS THEIVORA (WATERHOUSE).

("MOSQUITO BLIGHT.")

BY G. C. DUDGEON.

In reading over the descriptions of the various stages of *Helopeltis theivora* (Waterhouse), published in the *Indian Museum Notes* and Notes on Economic Entomology, I can find no correct account of the oviposition of this insect; I see also that a correspondent describes the eggs as being laid on the lower leaves of the bushes. This is a most misleading statement and, doubtless, what he took to be eggs of this blight, were that of another insect or perhaps not even eggs at all. In some rough notes which I made on the insect in 1888, resulting from a rather imperfect examination of the same, I discovered that the eggs were laid in the interior of the green stems of tea, and that their shape was slightly bent, elongate ovals with the upper end truncate. I also noticed at that time that their presence was made manifest by four short and stiff threads on the outside of the stem. These threads can be seen with the naked eye. The eggs, I observed, were laid in pairs; each egg bearing two threads on the outer and truncate end. I made known my discovery to several persons, but do not remember whether I published any account of it. I have since been assured, however, that this discovery was made before by some one else. This may be so, but I have not seen any publication announcing it.[1]

Helopeltis theivora Waterhouse.—Egg just previous to hatching, also empty egg shell from which the larva has emerged, magnified 58 diameters.

Recently, having more opportunities for examining both the eggs and the insect itself, I have verified my previous results except in the

[1] A description of the method of oviposition of *Helopeltis theivora* was first given by the late Mr. J. Wood-Mason in his Report on the *Tea bug and tea mite of Assam*. The eggs were subsequently described in *Indian Museum Notes*, Vol. II, p. 43, from notes furnished by Mr. C. N. Harcourt.—E. C. C.

case of the so-called threads on the outside of the stem. Hitherto I had supposed that the thread-like protuberance was produced by the female insect depositing a drop of viscous fluid on the egg and raising the abdomen, so as to stretch the same into a thin thread which the action of the air would harden. This seemed the more probable, because I had often noticed the females excreting a drop of fluid, and it was moreover borne out by the likeness to the method by which *Chrysopa vulgaris* (a European insect of the group *Neuroptera*) deposits its eggs, except, that in the latter case, the egg is laid on the top of the thread on the outside of a plant stalk. The purpose of the threads was ostensibly to keep these aperture in the stem of the shoot from being closed up by the healing action of the plant, which would suffocate the insect, without some provision of this kind. The idea of the mode of making these threads was so plausible that I had small cause to think that I should gain any more knowledge by testing it more thoroughly. It was, however, exploded by a friend of mine, who accidentally discovered on crushing the body of a female insect that each egg bore two thread-like protuberances at one end exactly similar to those of the deposited egg. This he pointed out to me, and the fact that two of those threads were attached to each egg before being laid was demonstrated in every case by microscopic examination.

It might be supposed, as the threads are intended to keep open the aperture in the stalk, that the young larva would emerge between them; by my magnified drawing fig. *a*, however, it will be seen that it does not do so, as one of the pair of eggs represented has only the upper shell left, showing that the larva emerged from the lower and interior end. Moreover, the stems in which empty egg shells are found will be seen to be hollowed out and brownish in colour; the core of the stalk having been eaten away, a small amount of gelatinous-looking matter alone remaining, which probably represents the digested portions of the stalk excreted by the larvæ.

The eggs are at first pure white, and are generally found in the green stems of tea which have been passed over by the leaf pluckers as being too hard for manufacture. Did the insect content itself with laying in the soft green stems, doubtless it would soon be exterminated on tea gardens where the leaf is not allowed to run out much. But apparently nature has provided against man, and the eggs are laid in the unpicked slightly-hardened stems. Just previous to the larvæ emerging the eggs become yellowish, the inner or more spherical end being streaked with orange red (representing the legs and antennæ of the larvæ).

In the Indian Economic Entomology, Vol. I, No. 4, the female insect only is described; presumably, therefore, the insect figured to illustrate the description is also a female; the ovipositor is not shown, however, al-

though it is more than half as long as the rostrum. It is difficult to distinguish it on the underside of the abdomen, folded, as it is, close against the dark shiny surface with which it matches well in colour; but, if the body be pressed, it rises from the surface and can be distinctly seen with the naked eye. It is in the form of a curved, corneous process rising from the centre of the sixth abdominal segment on the underside and reaching to the eighth segment. Its colour, like that of the posterior abdominal segments, is dark brown. Owing to the position of the egg when laid it will be seen that an ovipositor of this or similar form is necessary. I, however, do not think it probable that this instrument is also used for making the first puncture and cavity in the stalk wherein the egg is deposited. This is more likely performed by the rostrum or beak.

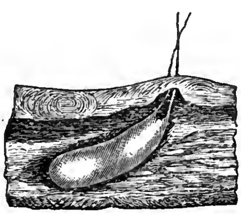
Abdomen and hind leg of *Helopeltis theivora* ♀, Waterhouse, showing the ovipositor raised from the under surface.

Nine or ten eggs are generally found in the body of a mature female, as, owing to their large size in comparison to the insect itself, there would scarcely be room for more. It is possible that more eggs are formed as they are laid.

It will be seen by referring to Mr. Waterhouse's description of the insect (Indian Economic Entomology, Vol. I, No. 4) that no mention is made of the colour or markings of the abdomen, although the latter are well shown in the plate given with it. I therefore conclude that the description was made from dried specimens from which the colour had gone, as soft-bodied insects do not preserve it long. The abdomen in fresh specimens of both sexes is invariably bright emerald green by transparency, marked dorsally on the third to ninth segments with shiny dark brown, fig. *b*. The extent of brown on the third segment is limited to a small dorsal patch or is altogether absent; on the fourth it extends over the whole dorsal region; on the fifth partially lateral and wholly dorsal; the remaining segments are all dark brown; the segmental divisions are greenish. The male differs from the female in having the pronotum very slightly tinged with yellow; the abdomen more slender and the absence of the ovipositor. The larvæ are greenish with deep ochreous or orange legs and antennæ; in some the abdomen is distinctly yellowish, although the same become green after having fed.

The stage in which the insect hybernates is still unknown, and although theories and explanations have been given by many on this point, I have never heard one which was not based on supposition, and occasionally most absurd ones. One which is most generally believed is, that the insect retires to the jungles in the cold season to feed on other plants, when the pruners have removed from the tea bushes all the leaves and stalks that were soft, leaving it nothing there to subsist on. In this connection, I would point out that, it does not appear to have been noticed to what jungle plant or plants it directs its attention, and I myself have looked in vain for them. It may be noticed, however, that certain plants of the genus *Mœsa* (kindly identified for me by Dr. King, C.I.E., etc., and Mr. G. Gammie, Officiating Curator of the Herbarium, Botanical Garden, Calcutta, as *M. montana* (D. C.), *M. ramentacea* (A. D. C.) and *M. indica* (Watt) occurring in the Darjeeling District from 1,500 feet to 5,000 feet, are blighted in much the same manner as tea. The leaves of these plants will often be found covered with punctures resembling those made by *H. theivora*, but generally larger. The insect which causes these is not of the same genus as *H. theivora*, although it apparently belongs to the same group and family. My description of it is given below, also a comparison of its generic characters with those of *Helopeltis* (*Signoret*).

From this description it will be seen that it is easily distinguished from true Mosquito blight, although the action and metamorphoses of both are nearly similar. I simply mention this in order to check casual observers from hastily concluding that jungle-plants marked similar to blighted-tea, are necessarily caused by Mosquito blight; whereas the insect causing these marks would likely be found innocuous to tea, as this one and many other allied species are.



(Egg of 'Mœsa' blight (capsidae) magnified 58 diameters.)

My own theory regarding Mosquito blight in the cold weather is, that it hybernates in a semi-dormant state near the root of the tea plant, either in the larval or imaginal stage, and, that, as in the case of many other insects, it does not require nourishment during this period. As soon as the weather commences to get warm, its vigour returns, and it com-

mences feeding on the young shoots, and is propagated throughout the year, being observed in Darjeeling to be worst about September and October. This seems natural, as, during each successive brood, the individuals multiply until the cold weather comes, which, without doubt, kills off many, and others, in their supposed dormant state, fall easy victims to their persecutors, leaving a scattered minority to reproduce their species in the spring. These conjectures I have not however been able to verify yet.

I am not able to recommend any exterminator for the pest. Expense of picking off the insects makes it prohibitive to do so. Syringing with some sticky substance such as a cheap preparation made from the gums of some jungle trees might be tried after a flush had been taken off. I am, however, of opinion that nothing that has as yet been suggested can be looked upon as an exterminator. Mr. Playfair's recent experiments with sulphur tend to verify what Mr. Christison and his employer long have known, *viz.*, that red *spider* blight is prevented for at least two seasons by the proper application of it; but that, however disinclined mosquito blight may be to feed on the sulphured leaves, they are not killed by it, and will simply fly off to "fresh fields and pastures new" until the sulphur has been washed away. Mr. Playfair shows the effect of strong heat or sunshine on a sulphured mosquito blight insect, but he is apparently oblivious of the fact that it avoids sunshine as much as possible, and therefore would be protected to a great extent from the action of the

Genus? differs from *Helopeltis* (*Signoret*) in having the first joint of the antennæ short, not so long as the head and pronotum; second and third joints moderately long; second longest; fourth joint short: scutellum without spine.

———sp? ♂ : Orange red; abdomen broad and concave on the upper side, unmarked; head transverse, short: eyes black and prominent: rostrum paler orange, thickened for the basal third of its length, rather short, reaching just beyond the coxæ of the anterior legs when folded beneath: antennæ almost the same length as the whole body; first joint thickened, short, reddish; second long; third shorter than second; fourth short, all three black: pronotum and scutellum unmarked, orange red, the former lengthened, forming a rather long neck, the latter triangulate: legs pale, semi-hyaline yellow, barred with orange red on the femora; the bases of the tibia also reddish: hemelytra with the basal two-thirds corneous and orange red, with a triangular black spot on the costa; the apical third fuscous, hyaline with a discal nervure orange; wings fuscous with the bases transparent, costal and discocellular nervures reddish. The hemelytra project far beyond the abdomen longitudinally. Total length of insect ♂ $\frac{6}{16}$ of an inch.

The female only differs from the male in being slightly paler in colour and in the underside of the abdomen having a curved, corneous, black, shiny ovipositor rising, as in *H. theivora* (Waterhouse) from the centre of the sixth segment and reaching to the eighth. The fertilised ♀ is streaked with whitish on the under side of the abdomen. Total length, ♀ $\frac{6}{16}$ to $\frac{13}{32}$ of an inch.

sulphurous fumes. It is seen most on cloudy days and in the morning and evening when the sun is off the bushes, hiding itself in the shade in the heat of the day. It would also be found that a sulphured insect in the open air would easily rid itself of the objectionable powder before the fumes of the same could affect it sufficiently to render it incapable of doing so.

The larva is wholly bright vermillion, with the exception of the eyes which are black. The hemelytra become semi-developed in the penultimate stage.

The ova are deposited in the same manner as those of *H. theivora, viz.*, in the interior of the slightly hardened stems of the food plant. I have always found them singly, in which way they differ from those of that species. They are white and shaped the same, *viz.*, elongate-ovals, slightly curved with the upper end truncate and produced at both angles into white hair-like processes which project through the green bark and are visible from the outside; these hairs are of the same length as the egg. The eggs become orange yellow before hatching, and the young larvæ feed on the interior of the stem on their first appearance.

Hab., Sikkim and Bhutan Himalayas from 1,500 feet to 5,000 feet (G. C. Dudgeon). Food plant, the young leaves of *Mæsa montana* (D. C.), *Mæsa ramentacea* (A. D. C.) and *Mæsa indica* (Watt). Some species of Convolvulus is also attacked by this or an allied form.

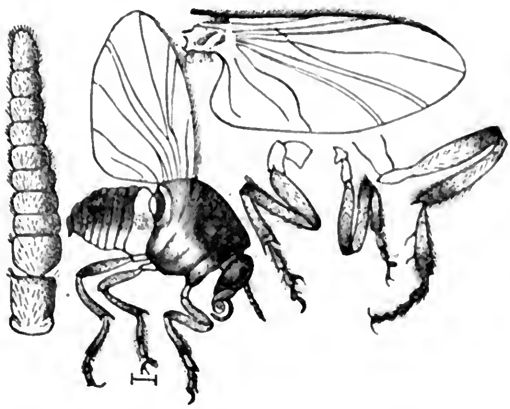
MISCELLANEOUS NOTES.

FROM THE ENTOMOLOGICAL SECTION.

BY E. C. COTES, DEPUTY SUPERINTENDENT, INDIAN MUSEUM.

The Potû fly.

In July 1893 specimens of the Potû fly collected in the previous May by Mr. C. G. Rogers, at an elevation of about 3,500 feet in the Tons valley of the North-West Himalayas, were forwarded by the Director of the Imperial Forest School, Dehra. Careful comparison of the specimens with the late Dr. Becher's figures and description of his *Simulium indicum* from Assam shows them to be identical with this species.



The insect is noticeable on account of its relationship to the notorious "black fly" (*Simulium molestum*) of the North American continent. It is said to be very troublesome in the North-West Himalayas but little beyond the bare technical description of the species has hitherto been recorded. A series of questions were therefore submitted to the Director of the Forest School with a view to eliciting such information as might be forthcoming from the forest officers stationed in the School circle. From the replies kindly furnished by Messrs. Gamble, Rogers, Moir, and Smythies the following points seem to be established.

The Potû is so similar both in its bite and superficial appearance to the *pipsa* of Sikkim, as to make it likely that it is either identical with or very closely allied to this form. In view therefore of the fact that the specimens from the North-West Himalayas agree exactly with Becher's figure of a specimen from Assam, the conclusion seems to be a

justifiable one that *Simulium indicum* occurs in the intermediate ranges of the Himalayas. Both in the North-West Himalayas and in Sikkim the insect chiefly frequents elevations ranging from 3,000 to about 10,000 feet. It has been noticed as specially common in Chir (*Pinus longifolia*) and Deodar (*Cedrus Deodara*) forest, over newly disturbed soil, and where sheep and buffaloes have been camping, but is by no means confined to such localities.

In the North-West Provinces it is said sometimes to occur in such numbers that the air seems to be full of the flies, but it is less abundant in Sikkim where the climate is moister. The worst months are April, May, and June, *i.e.*, the hot season, but the flies are not uncommon in the low valleys in February and March. When the rainy season sets in they usually disappear, and are not seen again until the following spring.

The insect flies noiselessly and its bite in the first instance is so painless that the creature is seldom noticed at work until its yellow and black body is to some extent coloured with the blood it has absorbed. It is then too late to do much good by brushing it away.

It leaves a characteristic mark due to the presence of a little globule of blood, about the size of a pin's head, beneath the skin. The bite soon becomes irritable, but the effects vary in different individuals. Generally speaking the irritation passes off in a few days, but in the case of new comers and persons in bad health it often causes troublesome sores and ulcers. Mr. G. C. Rogers writes: "This year my cook was so badly bitten at Saia that his whole face swelled up and he was in great pain. Another of my servants was very badly bitten in the Upper Tons valley and got his legs so sore that he could hardly walk."

The common method of treatment is to squeeze the blood out of the wound immediately, as this allays the intolerable itching, though even then some swelling is usually produced. Deodar and Eucalyptus oil also are freely used for rubbing over the hands and face to keep off the insects which are most annoying where they occur.

Dogs are sometimes bitten upon the nose by the insect so as to draw blood. Cattle and sheep also are thought to be attacked, but no definite information is available upon this point.

Nothing has been observed of the life history of the insect, and, although the localities where it occurs are never very far from hill streams, it has not been specially noticed as prevalent near to water.

From what is known of the habits of European and American species of the same genus it is to be expected that the female lays her eggs in quick flowing hill streams, the larval and pupal stages being passed in the water.

The specimens forwarded to the Indian Museum proved to be all

females with mouth parts developed for blood sucking. The male is likely to be a harmless insect with rudimentary mouth parts.

The figures are after Becher. The natural size of the insect is indicated by a hair line.

Identification of Dipterous parasites.

A point which has been brought forcibly to notice in prosecuting the investigation of the Economic Entomology of India has been the extent to which defoliating caterpillars in this country are kept down by the attack of parasitic Diptera. Again and again caterpillars sent to the Museum as occasioning damage to agricultural and forest plants have been found to harbour these parasites in such numbers as seriously to interfere with the rearing of imagos for identification. And there is little doubt that the sudden disappearance of destructive caterpillars, which is so characteristic a feature of this form of attack in India, is very frequently due to this cause. The loss and inconvenience caused by the Bengal silk-worm fly (*Tricholyga bombycis*, Becher) to rearers both of the various mulberry feeding varieties and also of the castor oil feeding Eri (*Attacus ricini*) is well known, but the question of the identity of the parasites of the various defoliating species has not hitherto been satisfactorily determined.

The question is obviously one of very considerable importance, in view of the extent to which these parasites act as a natural check upon the multiplication of destructive caterpillars. The possibility, however, of propagating them artificially depends very largely upon the extent to which different species of Lepidoptera are capable of harbouring the same species of parasite. The number of species of caterpillars which are liable at different times to cause injury as defoliators in this country is enormous. Indeed it is hardly too much to say that almost every plant has its own special enemies amongst the Lepidoptera. It is only occasionally however that any particular species of caterpillar multiplies sufficiently to cause serious injury. If therefore each caterpillar had special parasites to itself the difficulty of keeping up a supply of these beneficent creatures, in years when the caterpillar was scarce, in order that they might be available for distribution when the caterpillar was actively injurious, would be almost insurmountable. If, on the other hand, it should prove that numerous species of caterpillars are subject to the attack of one species of Diptera the difficulty of keeping up the supply would be very much lessened. In particular it was desirable to ascertain the extent to which the species *Tricolyga bombycis* attacks caterpillars other than the silk producing *Bombyx* and *Eri*, for an unfailing supply of this parasite is always available in the silk rearing districts of Bengal.

With this object parasites from a number of different caterpillars have been reared in the Indian Museum, and a representative series of them has recently been examined by Herr F. M. Van der Wulp of La Hague, who has made this interesting group of insects his especial study. The result of his examination, so far as the new species are concerned, is given on pages 9—17 of this volume, and it here remains to record the details of the caterpillars from which they were reared. The most noticeable features are, firstly, that the Bengal silk worm fly (*Tricholyga bombycis*, Becher) also attacks the two destructive defoliating caterpillars *Dasychira thwaitesii*, Moore, and *Olene mendosa*, Hübn., and secondly, that in no less than three instances the same species of caterpillar has been simultaneously attacked by more than one species of Dipterous parasite.

Number.	History of the Parasite.	Determination.
1653/8	Bred from *Attacus ricini*, Boisd .	*Tricholyga bombycis*, Becher.
1598/8	Bred from *Bombyx mori*, Var .	*Tricholyga bombycis*, Becher.
4107/10	Bred from *Antheræa mylitta*, Drury	*Crossocosmia sericariæ*, Rond, *Masicera grandis*, Bigot
4597/12	Bred from *Olene mendosa*, Hübn .	*Masicera subnigra*, Wulp., n. sp.
6526/12	Bred from *Olene mendosa*, Hübn .	*Tricholyga bombycis*, Becher.
711/8	Bred from *Cœnodomus hockingii*, Walsingham	*Crossocosmia biseriata*, Wulp, n. sp.
6847/10	Bred from *Leucania extranea*, Guen	*Masicera castanea*, Wulp., n. sp.
722/8	Bred from *Dasychira thwaitesii*, Moore	*Masicera dasychiræ*, Wulp., n. sp.
850/8	Bred from *Dasychira thwaitesii*, Moore	*Tricholyga Bombycis*, Becher.
6573/12	Bred from a *hair covered* (?) Lasiocampid caterpillar destructive to rice in the Central Provinces .	*Demoticus strigipennis*, Wulp., n.sp.
6574/12	Bred from a *hair covered* (?) Lasiocampid caterpillar destructive to rice in the Central Provinces .	*Calodexia lasiocampæ*, Wulp., n. sp.
13	Believed to be the imago of the Dipterous parasite which is known to attack the locust *Acridium peregrinum*, Oliv., but the specimen is doubtful as it was not actually reared in the Museum	*Miltogramma, 12 punctata*, Wulp., n. sp.

Mango Maggots.

Extensive injury to mangoes by a maggot which is likely to be the larva of the Dipterous insect *Dacus ferrugeneus* Fabr. referred to in these *Notes*, Vol. II, p. 165, is reported from Berhampore. Baboo N. G. Mukarji writes:—"They annually visit one of the famous orchards of this district the Katgola garden—and spoil almost every fruit of the Maldah varieties which ripen later than those of the country varieties." The observation is of interest as some doubt has elsewhere been expressed as to whether really sound fruit is attacked by this insect.

Melasoma populi, Linn.

Specimens of a Chrysomelid beetle found by Mr. C. G. Rogers in Deoban, North-West Himalayas, also a Tachinid fly parasitic on it, were forwarded in July 1893 by the Director of the Imperial Forest School, Dehra Dun. The Chrysomelid proved to be unnamed in the Indian Museum collection, but a careful comparison of it with Olivier's description of *Melasoma populi*, Linn; which has been recorded as feeding upon willow trees in Europe, did not disclose any appreciable difference between the two forms. It may be looked on, therefore, as belonging to this species. The parasite is a Dipterous insect which seems to be most nearly related to the genus *Masicera*, as represented in the Museum collection; the specimen, however, is in too poor a state of preservation for satisfactory identification.

The following information is taken from a series of rough, but most interesting notes made by Mr. Rogers. The larvæ of the beetle were first noticed on 9th June 1893 in Deoban, 9,000 feet above sea level, in the North-West Himalayas. They ranged from 0·10 inch to 0·51 inch in length. The head was black, the body yellowish white with black markings. On the back were numerous paired glands from which little transparent globules of strong pungent smelling fluid were extruded when the insect was touched. After a while the globules were drawn in again into the glands, but could be again extruded two or three times over, before the insect became exhausted. The odour, which is compared to that of prussic acid, scented the whole bush where they were feeding, and was a very characteristic feature of the insect. The larvæ which were kept in captivity moulted but once before pupating. Pupæ were formed between 14th and 21st June. The chrysalis had much the same general markings as the larvæ. It remained partially enclosed in the larval skin. In nature the pupæ were found suspended from the undersurface of leaves and branches of the food plant. Beetles began to emerge on 22nd June and continued to appear in the rearing box until 27th June. They afterwards lived for about a week in confinement, but,

as in this period they were carried down to Dehra Dun, elevation 2,100 feet above sea level, their ordinary period of existence in this stage is likely to be longer. Out of fifty-one larvæ and pupæ six were found to harbour grubs of the Dipterous parasite noticed above. The grub pupated inside the body of the beetle larva, flies emerging on 30th June.

Phædon brassicæ, Baly.

In a report, dated 28th December 1893, forwarded by the Sub-divisional Officer, Golaghat, the mustard crop in part of the sub-division was referred to as infested with an insect known as *Sorohapok*. Specimens were forwarded to the Museum in the early part of February, at the instance of the Director of Land Records and Agriculture, Assam. They proved to belong to a species of Chrysomelidæ, genus *Phædon*, not previously reported in connection with crops in India, but closely related to the species *Phædon betulæ*, Linn., which attacks the mustard plant in England. The specimens were, therefore, sent to London to Mr. Martin Jacoby, who has made a special study of Phytophagous Coleoptera. Mr. Jacoby has since very kindly examined them and reports that they belong to the species *Phædon brassicæ*, Baly, also found in China and Japan.

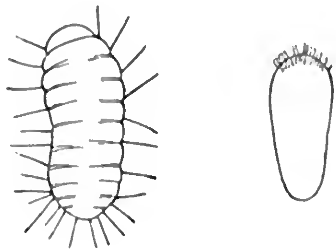
Leptispa pygmæa, Baly.

In November 1893 Chrysomelidæ of the sub-family Hispinæ were forwarded by the Assistant Superintendent, Poona Farm, Kirkee, with the information that they attacked the developing leaf of sugar-cane checking the growth and eventually killing the plant. The species proved to be new to the Indian Museum collection, so specimens were forwarded to Mr. Martin Jacoby in England who has made a special study of Phytophagous Coleoptera. This gentleman has kindly examined the specimens and identified them as belonging to the species *Leptispa pygmæa* described by Baly in his Cat. Hispid. 1858, from Ceylon.

Cheroot borer.

From some excellent material furnished by Mr. J. Cleghorn the identity of the eggs described in these *Notes*, Vol. III, p. 6, as believed to belong to the destructive cheroot borer *Lasioderma testaceum*, Redt., has been ascertained beyond doubt. By jarring infested cheroots over black paper Mr. Cleghorn was able to secure large quantities of eggs. Numbers of these hatched out in the Museum on various dates in January, producing the characteristic larva of the beetle. Mr. Cleghorn also observed the act

of oviposition and writes that eggs laid on the 10th January hatched out on the 22nd and 23rd of the same month, while others laid on the 15th and 16th hatched between the 26th and 28th, the temperature at the time ranging from 74° F. to 78° F.



A number of live beetles furnished by Mr. Cleghorn have since been shut up in a bottle of cheroots which had previously been sterilized by baking([1]). The insects were received on the 17th January 1894 and several of them almost immediately made their way into the cheroots between the layers of tobacco at the ends. Their dead bodies were found lying about three or four days later, so the life of the insect in this stage must be short. The conclusions to be deduced from the above, when taken in conjunction with what has previously been ascertained, are as follows.—The eggs of the cheroot borer are liable in Calcutta to be laid in made cheroots at such different seasons of the year as August and January. Oviposition therefore may be expected to go on all the year round. In the cold season in Calcutta the eggs are able, under favourable circumstances, to hatch in less than a fortnight, and as warmth and moisture usually accelerate development amongst insects the period of incubation is likely to be even shorter in the rainy

([1]) These cheroots were an old set which have been for more than two years in the Entomology room. They were baked for twelve consecutive hours on 16th and again on the 17th June 1891, the water oven on both occasions being kept at a uniform temperature of about 180° F. They have since been kept in a bottle in the Entomology room corked in such a manner as to admit air without leaving space for the beetles to enter. They have been periodically damped with water so as to create the conditions most favourable to the development of the insect, and as no signs of attack have appeared after an interval of two years and seven months, it may be taken as certain that they have been efficiently sterilized.

season. The figure shows the egg and newly hatched larva dorsal view both magnified about fifty diameters.

Postscript, 13th April 1894.—Two lively beetles have to-day emerged, characteristic holes being apparent in the sides of two of the cheroots. On cutting open these two cheroots another beetle just ready to emerge was found inside, also several nearly full-grown larvæ. It should be observed that the cheroots have been periodically moistened during the past few months, so development is likely to have been somewhat quicker than it would otherwise have been.

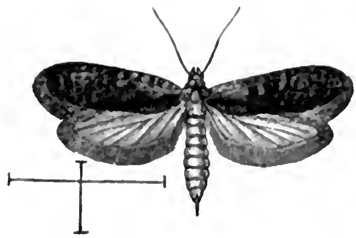
White grub in Surat.

In January 1894 a specimen was forwarded by Mr. J. Mollison of a grub which had been doing a great deal of damage to Brinjal (*Salanum melongena*) in Surat. In some fields every second plant was attacked, the loss occasioned being estimated at not less than from R50 to R100 per acre. Writing on 16th January Mr. Mollison remarked that the grubs were then deep down in the ground, but that the cultivators said they had previously found them near to the surface, the insect being specially prevalent after a heavy dressing of manure. The specimen forwarded to the Museum unfortunately died upon the journey across India, so could not be reared for specific determination. The remains however were identified as belonging to the larva of one of the Lamellicorn beetles, probably one of the Melolonthini and therefore allied to the "white grubs" which occasionally prove destructive on Tea and Coffee Estates. Both in Sikkim, where Melolonthini larvæ did much damage some ten years ago, and also in Ceylon where they at one time seriously threatened the Coffee industry, the only measure that seems to have been adopted upon any considerable scale was that of digging out the grubs by hand. This process, laborious as it no doubt is, was found worth adopting in these cases and is likely at present to be the only one that will find favour in the Surat brinjal fields. Other methods of dealing with Melolonthini larvæ are described in these *Notes*, Vol. III, pp. 4 and 102.

Boswellia serrata borers.

In January 1893 a small piece of *Boswellia serrata* wood (salai) was forwarded to the Museum by the Director of the Forest School. It was perforated in all directions with small round holes ranging from less than a millimetre to more than four millimetres in diameter. The holes were

largely stopped up with fungoid growth but in them were found live Coleopterous and Lepidopterous larvæ. The Coleopterous larvæ were insufficient for precise identification but a moth was reared in the Museum from one of the Lepidopterous larvæ. It proved to be a



Microlepidopterous species new to the Indian Museum collection. It has since been examined by Lord Walsingham who considers it congeneric with the species figured by Snellen (Tijd. Voor. Ent. XXVIII, Pl. II, figs. 1-4, 1884) under the name of *Hapsifera rugosella*, n. sp. The insect is not unlikely to be a representative of a new species but further specimens are required to enable it to be described. The figure shows the moth dorsal view enlarged. The natural size is indicated by hair lines.

Acacia catechu borer.

In July 1893 specimens were forwarded through the Imperial Forest School, Dehra, of an insect found tunnelling into the sapwood of *Acacia catechu*. It proves to be a beetle of the family Ptinidæ which has previously been sent to the Indian Museum as attacking *Terminalia belerica* timber. Its precise identification has not yet been ascertained but the insect at present stands under the genus *Sinoxylon* in the collection. Along with the Ptinidæ beetle was a Hymenopterous insect which is likely to be parasitic upon the borer. It has not yet been identified.

Wrightia tinctoria girdler.

In September 1893 a Cerambycid beetle identical with specimens in the Museum collection which stand under the name of *Xylorrhiza adusta*, Wiedm. was forwarded through the Dehra Forest School from the Conservator of Forests, Southern Circle, Madras. The insect was reported as ringing the branches of *Wrightia tinctoria*, a habit which does not appear to have previously been noticed in connection with this species.

Cotton weevil in Lahore.

A Curculionid beetle found upon Egyptian cotton, in the Agri-horticultural Gardens in Lahore, was forwarded to the Museum in July 1893 through the office of the Director of Land Records and Agriculture, Punjab. The insect proved to be unnamed in the Indian Museum collection. It has since been examined by Mons. Desbrochers des Loges, who identifies it as a new species of *Myllocerus*. The material however is insufficient to enable the species to be satisfactorily described.

Icerya ægyptiacum.

One of the most interesting accessions to the Museum collection during the past year has been the Coccid *Icerya* (*Crossotosoma*) *ægyptiacum*, Douglas, which has acquired considerable notoriety in Egypt on account of the damage done by it to fruit trees in that country. The species was first reported from India in March 1893 by Mr. R. Newstead, Curator of the Grosvenor Museum, Chester, England, who forwarded to the Indian Museum some specimens he had received from the Madras Presidency.

Mr. Newstead found that the Madras specimens were associated with a minute Hymenopterous insect which has been identified by the United States Entomologist as a species of *Tetrastichus*. Mr. Newstead has written an interesting paper upon the subject which appears on pages 27—31 of these *Notes*.

In view of the great damage occasioned in Egypt by the Coccid and its close relationship to the disastrous fluted scale (*Icerya purchasi*, Maskell), the matter was thought of sufficient importance to make it the subject of a letter of inquiry from the United States Entomologist for whose examination the *Tetrastichus* had been submitted. In this communication attention was specially drawn by Dr. Riley to the desirability of ascertaining the primary host of the *Tetrastichus*, for as the latter belongs to a genus the members of which have hitherto proved to be invariably parasitic upon Hymenoptera, the relationship to be expected between it and the Coccid is that of a secondary nature only.

In the latter part of May 1893 the Coccid was recognized in Calcutta on some ornamental bushes in the Indian Museum compound, and an attempt was made to rear the insect in the Entomological Section.

The form found was the wingless female, which itself is bright red in colour but so covered with the white flakes of feathery wax which it secretes as to appear like a little lump of cotton wool upon the leaf. The insect was attended by numerous ants of the species *Cremastogaster*

Walshi, Forel, which were to be seen busily prodding the scale insects [with their antennæ, no doubt in order to extract honey dew. The stationary character of the insect made it somewhat difficult to transfer from one twig to another, but it was found that by keeping the twigs in tightly closed glass stoppered bottles they remained fresh enough for the insect to feed upon them for several days. After being shut up for a short time by themselves drops of colourless fluid accumulated upon the bodies of the *Icerya.* To the taste this fluid has a faintly sweet flavour and is no doubt the secretion for the sake of which the insect is attended by the *Cremastogaster.* Numbers of this ant therefore were caught and shut up with the Coccids, but they did not thrive in confinement and spent most of their time endeavouring to escape.

After a few days numerous specimens of the *Tetrastichus* appeared in one of the bottles. Careful examination was immediately made of the Coccid-covered sprig, and after a good deal of searching, what seemed like a tiny cocoon was found amongst the waxy debris. On microscopic examination the cocoon was found to consist of the shrivelled skin of the *Icerya.* A similar skin was subsequently found containing several specimens of the *Tetrastichus* nearly ready to emerge, but the most careful examination was not rewarded with the discovery of any remains which could have belonged to a primary Hymenopterous host upon which the *Tetrastichus* could have been directly parasitic. In view of the numbers in which the *Tetrastichus* appeared, and of the fact that the glass stopper with which the bottle was closed precluded the possibility of the escape of any other insect, the conclusion seemed at first to be a justifiable one that the *Tetrastichus* was directly parasitic upon the *Icerya.* A cocoon was subsequently forwarded to Dr. Riley, who most kindly examined it and was able to confirm the observation that it merely consisted of the dried skin of the *Icerya.* He also succeeded in extracting from it an adult *Tetrastichus* and the exuviæ of two or three more, but in view of the uniformity of habit hitherto found in the genus *Tetrastichus* he still considers it most probable that further research will yet reveal some intermediate Hymenopterous host.

Subsequent absence from Calcutta, from the early part of August until the beginning of November, has put a temporary stop to the investigation, for although the *Icerya* was common enough in the beginning of August it was found to have almost completely disappeared from the compound in November. A further attempt will be made when the insect again appears.

In the course of the attempt to rear the insect a few points were made out which are of sufficient interest to be worth recording. The

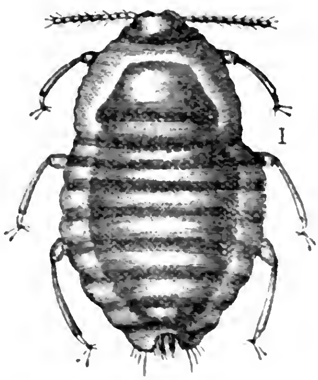
eggs of the Coccid are elongated and rounded in shape, somewhat less than a millimetre in length by about half this measure in diameter. Two forms of larvæ were observed, the one as described and figured by Douglas (Ent. M. M. March 1890, p. 79), which is somewhat rounded in outline and characterised by the possession of six well marked posterior bristles, the other more elongated in outline and characterised by the possession of but two well marked posterior bristles which gradually develope into rope like appendages as the creature advances in growth. So far as was made out the form with six bristles develops eventually into the wingless female. The development of the form with two appendages was not completely traced and it is possible it may belong to some other species.

In close attendance upon the *Icerya* were found two species of Coccinellidæ. These were submitted to Mr. L. O. Howard, Acting United States Entomologist, through whose kindness they have been identified as *Platynaspis villosa*, Mulsant, and *Scymnus* sp. respectively. The larva of the *Platynaspis* is a brownish grub which moves openly about amongst the *Iceryas*, and eventually transforms into a pupa upon the same twig. The immature form of the *Scymnus* was not traced, but a solitary larva was found, which may possibly have belonged to this species. It was covered all over with white cottony appendages so as very closely to mimic the *Icerya*, and its habit of keeping very still in the corner of a leaf when disturbed further enhances the likelihood of its being mistaken for this insect. It was unfortunately lost before it had developed sufficiently for determination.

Neither of the Coccinellidæ were noticed as particularly active in feeding upon the *Icerya*. They seemed also far too few in numbers to have much effect in keeping down the insect. The *Scymnus* indeed was so scarce that less than half a dozen specimens in all were discovered. The *Platynaspis* on the other hand, which was slightly more common, is a native of Europe and therefore likely to occur in Egypt, for it is not probable that an insect which occurs both in Calcutta and in Europe and is able to withstand the enormous range of climate which this difference in habitat involves would have failed to make its way into Egypt which lies geographically between these two extremes. Some other agent would therefore seem to be required to account for the failure of the *Icerya* to multiply sufficiently to become destructive in India. The primary host of the *Tetrastichus*, if such exist, may no doubt be the cause, but in this case the prospect is not reassuring, for even if the primary host of the *Tetrastichus* is not exterminated by its minute enemy, a contingency which would seem by no means impossible in view of the numbers in which the *Tetrastichus* has appeared, it is likely to lead far too hunted

an existence to have much chance of continuing the good work of keeping down the *Icerya* effectively.

Dactylopius bromeliæ. Specimens have been forwarded to the Museum by Baboo N. G. Mukharji of a Coccid which has been reported as injuring mulberry bushes in Berhampore. The insect has the peculiar effect of causing the mulberry leaves to wilt up and become puckered. Baboo N. G. Mukharji reports that he has found Kerosine emulsion of use against the insect. Writing in July 1893 he remarks—"the field treated last November is almost unaffected while all the other fields are just as bad this year as in previous years." The insect proved to be new to the Indian Museum collection, so was submitted to Mr. W. M. Maskell, who kindly examined the specimens and was able to identify them with some doubt as belonging to the species *Dactylopius bromeliæ*, Bonché, for although anatomically similar to this species the representatives that were forwarded differed in not possessing a covering of cottony matter. The absence of the cottony covering was no doubt merely due to the action of the alcohol in which the insect was preserved, for specimens subsequently obtained proved to be covered with a considerable amount of white cottony secretion. The figure is from a specimen from Berhampore.



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Mr. Maskell furnishes the following note upon the subject of the insect:—

Dactylopius bromeliæ, Bonché.

Bonché, Naturgesicht, 1834, p. 20, 2.

Signoret, Annales de la Soc. Entom. de France, December 1874, p. 310.

Adult female pale reddish brown, or yellowish-brown: form convex, sub-elliptical, rounded in front and rather acuminate posteriorly: length averaging about $\frac{1}{12}$ inch. Antennæ of eight joints (rarely seven): joints sub-equal except the last which is longer than any two others together: the pubescence of the antennæ is not close or long. Feet moderately long: the tibia and tarsus rather strongly haired on the inner margin, with two spines at the extremity of the tibia: the four digituler are rather long and strong: the tarsus is more than half as long as the tibia. Anal tubercles somewhat prominent, each bearing a long seta: anal ring with six hairs. On each segment of the body is a row of shortish hairs, mingled with circular spinnerets: and on the head, between the antennæ, the hairs form a rather thick tuft.

Larva yellow or brownish: form elliptical, tapering somewhat posteriorly: anal tubercles prominent: antennæ of probably six sub-equal joints. Length of larva about $\frac{1}{40}$ inch.

Male unknown.

Habitat—on *Bromelia, Hibiscus, Canna*, Zanzibar, and probably South America: on *Mulberry*, Bengal.

Aspidiotus transparens, Green.

The presence of the coccid *Aspidiotus transparens*, Green, was noticed upon some tea branches, forwarded to Calcutta in January 1894 from Jalpaiguri. The insect was only represented by a few scattered females upon one of the leaves, but its occurrence in this locality is of interest as it does not appear to have been previously recorded from India. It was originally described by Mr. E. E. Green, who found it upon the tea plant in Ceylon.

Chionaspis brasiliensis.

A coccid, forwarded by Mr. E. E. Green, as found attacking cultivated ferns in Ceylon in September 1892, has been identified by Mr. W. M. Maskell as *Chionaspis brasiliensis*, Signoret. Mr. Maskell notes that the original species was from Bahia and as it has since been noticed on an orchid from New South Wales, it is likely to have a wide tropical and sub-tropical range.

Sugarcane scale insect.

In September 1893, specimens were forwarded from Baroda, by Mr. T. H. Middleton, of a scale insect which attacks sugarcane leaves, and is known locally as *Masi*. The insect proved new to the Indian Museum collection, so was sent to New Zealand for examination by Mr. W. M. Maskell, who has since kindly examined it and reports that it represents the pupæ of a species of *Aleurodes* not yet precisely identified.

Orange blight.

In January 1893, a number of blighted orange leaves were forwarded to the Museum by the Revd. Mr. Carleton, of Kotgarh, near Simla. The leaves were found to be covered with vast numbers of little scale-like insects. Mr. Carleton reported that the blight had appeared upon one tree about two years previously, and the following year had spread to all the orange trees in the orchard. Its effect was to stop both growth and fruiting. The insect proved to be new to the Indian Museum collection, but as it was obviously allied to the coccidæ, attention was directed to the system of kerosine spraying and gas treatment, described in previous numbers of these *Notes*, which have been employed with much success against this class of insects in the United States.

In the mean time the specimens were submitted to Mr. W. M. Maskell, the specialist on coccidæ, for further examination. Mr. Maskell has since been so kind as to examine the specimens, and reports that they are the larvæ and pupæ of a species of *Aleurodes*. The material was insufficient for precise identification, but the species is likely to be allied to *Aleurodes quercus*, Signoret, though the dorsal punctuation is scattered instead of being in radiating lines as in this form. Mr. Maskell notices that the adults are likely to be small four-winged flies, probably yellowish in colour, with wings covered with white powder or slightly spotted. The remedies he recommends are similar to those used against coccidæ.

A Quetta rose blight.

In September 1892, leaves covered with the remains of white cottony looking blight were forwarded by Mr. C. F. Elliott, who wrote that rose bushes in Quetta were much affected in this way. The insect has been kindly examined by Mr. W. M. Maskell, who identifies it as an Aleurodid possibly allied to the European form *Aleurodes protella*, Linn. The material, however, which consists chiefly of empty pupal cases covered with white cottony secretion is insufficient for precise identification.

Spruce fir *Chermes.*

Specimens of an insect which forms galls upon the spruce fir (*Abies Smithiana*) in the North-Western Himalayas were forwarded to the Museum in July 1893 by Mr. A. Smythies. The gall consists of an abnormal growth of the terminal shoot which becomes superficially much like a small fir cone. The insect is either identical with, or very closely allied to, the Aphid *Chermes coccineus*, Ratz., which attacks fir-trees in a very similar manner in Europe. Specimens have been forwarded to Europe for comparison with this form.

At Deoban (9,200 feet above sea-level) Mr. Smythies observed the mergence of the winged imago on the 21st July. In the months of May and June immature specimens only were to be found.

Postscript.—The specimens have since been examined by Mr. G. B. Buckton, F.R.S., who identifies them as belonging to the species *Chermes abietis* of Linnæus and Kaltenbach. A full account of the habits of this insect may be found in Mr. Buckton's masterly work upon British Aphides, Vol. IV, pp. 24-33. The species is new to the Fauna of India.

Tea Aphid.

Some Aphids found upon the under surface of tea shoots were forwarded in March 1893 through the Chemical Adviser to the Indian Tea Association from a tea garden in Assam. The specimens arrived in too poor a state of preservation for precise identification, but are likely to belong to the species *Ceylonia theaecola*, Buckton, described and figured in these *Notes*, Vol. II, pp. 34 and 35.

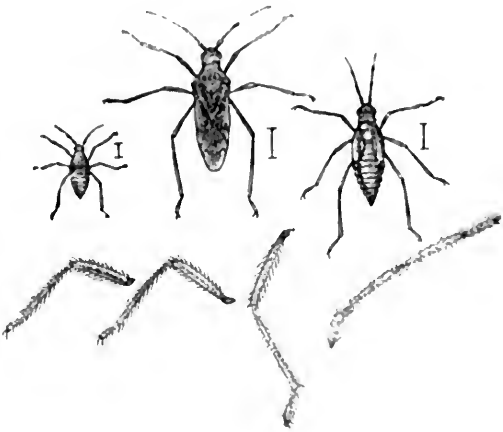
Similar specimens were received in August 1893 from Cachar, through the Editor of the *Asian*. In this case the insect was described as found only on the young shoots of indigenous tea, its effect being to cause the leaf to shrivel up and turn black.

Aphidæ in Calcutta.

In December 1893 a good deal of damage was occasioned in the compound of the Presidency Jail, Calcutta, by Aphidæ, which attacked cabbage, radish, and other cold weather vegetables, killing off the seedlings and threatening the supply for the convicts. Specimens furnished by Mr. P. Donaldson were found to be either identical with or very closely allied to the common European form *Aphis brassicæ*, Linn., which has been referred to in these *Notes* as attacking the mustard plant in Bengal.

In January 1893 specimens were forwarded by the Assistant Director of Land Records and Agriculture, Bengal, of an insect thought to be responsible for the curling and twisting of the leaves of tobacco plants grown on the Sibpore Experimental Farm.

Tobacco Homoptera.



Five varieties of tobacco had been grown side by side, and it was found that the milder and more succulent tobaccos suffered to a very much greater extent than the stronger and more pungent kinds. The insect proved to be new to the Museum collection. It has been kindly examined by Mr. G. B. Buckton, F.R S., who considers it to be related to the Teltigidæ. The species, however, is an obscure one and would seem to have been hitherto undescribed. The figure shows the larva in two stages of growth; also the imago with much enlarged diagrams of its antennæ and legs. The natural sizes of the insects are indicated by hair lines.

Postscript.—In February 1894 injury was again reported to tobacco plants in the Sibpore Experimental Farm. In this case the enemy proved to be a species of Aphidæ, which has been identified through the kindness of Mr. G. B. Buckton, F.R.S., as belonging to the species ***Siphonophora scabiosæ***, Schrank. Associated with the Aphidæ were numerous Coccinellidæ larvæ. Some of these transformed into beetles in the Museum between the 17th and 19th February 1894. They proved to belong to the species ***Chilomenes sexmaculata***, Fabr. as determined in the Museum collection.

Leptocorisa acuta.

Since the publication of the last number of these *Notes*, specimens of the rice sapper *Leptocorisa acuta*, Thunb, have been forwarded both from the Officiating Collector of the Balasore District, through the Director of Land Records, and also from the Agricultural and Horticultural Society of India, but nothing further of importance has been ascertained about the habits of this species.

Some interest attaches to a consignment of paddy forwarded by Mr. W. R. Lawrence, Settlement Officer, Kashmir, as suffering from a disease known as Rai Rai. This disease is said to occur in hot still weather and results in a withered ear with shrivelled unformed grain. It is so prevalent in Kashmir as to occasion very serious damage. No insects were found in connection with the paddy forwarded, but the appearance of the ears, with their empty husks, was so similar to that of paddy attacked by the rice sapper that it is possible the injury may have been due to this cause. The matter would seem to be of sufficient interest to be worthy of further investigation.

Canthecona furcellata.

Interesting confirmation of the habit of the Pentatomid *Canthecona furcellata*, Wolff, noticed in Vol. II, p. 165 of these *Notes*, has been received from the Rev. A. Campbell, who has forwarded specimens from Manbhoom. Writing in November 1892, Mr. Campbell observes that its method of procedure is to alight at a short distance from the caterpillar. It then inserts its long proboscis into the body of its victim, and sucks. It takes a considerable time for it to kill the caterpillar.

Oxycarenus lugubris, Motsch.

Specimens of the Lygæid *Oxycarenus lugubris*, Motsch., were forwarded in October 1893 by the Director of Land Records and Agriculture, Punjab, as infesting Egyptian cotton plants in the Lahore Agri-Horticultural Gardens. The insect has been figured in these *Notes*, Vol. II, p. 32. It has previously been reported both from the Madras Presidency and Ceylon in connection with cotton, so is likely to occur throughout India.

Ground nut Lygæid.

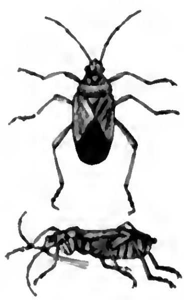
An insect, called in Tamil *Naval puchi*, has been reported by the Deputy Director of Land Records and Agriculture, Madras, as attacking ground nuts when lying in the pod in store. The result of its attack is to render the seeds light

and poor in oil. The same insect is also said to attack *gingelly* when the plants are stacked prior to thrashing. Specimens were forwarded to the Museum in August 1893. They proved to belong to a species of Lygæidæ as yet unnamed in the collection, and have been forwarded to Europe for identification.

Postscript.—They have since been examined by Dr. E. Bergroth, who identifies the species as *Beosus pallens*, Dall.

Dysdercus cingulatus, Fabr.

Specimens of the Lygæid *Dysdercus cingulatus*, Fabr., as determined in the Indian Museum collection, were forwarded from Kirkee on 7th December 1893 by Mr. J. Mollison, with the information that they were damaging cotton upon the Government farm. The plants attacked were of the Khandesh *varadi* variety which ripens its bolls in November

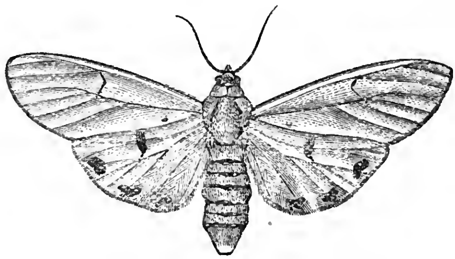


and December. The insects were found in large numbers upon almost every plant and appeared to feed upon the immature seed contained in the bolls. Representatives of the same species were forwarded about the same date by the Director of Land Records and Agriculture, Punjab, as found upon Egyptian cotton. The insect undoubtedly does a considerable amount of damage by tapping the bolls and drawing up the sap, much the way that the mosquito sucks up blood. Further references to it may be found in these *Notes*, Vol. II, pp. 33, 44, and 166. The figure shows the insect natural size.

Aloa lactinea, Cramer.

In January 1893, Mr. T. H. Middleton forwarded from Baroda a moth reared from a caterpillar which is known locally as *katra*. It proved to be an Arctiid belonging to the species *Aloa lactinea*, Cramer, as determined in the

Indian Museum collection. Together with it were the remains of a Tachinid said to be parasitic on the caterpillar. The material in this case. however, was in too poor a state of preservation for specific identification.



According to an interesting account furnished by Mr. Middleton in July 1892 the *katra* insect has been known near Baroda for ten years, and it is said that villages to the north suffered before those near the city. The insect seems to be common in the light soil tract lying between Baroda and Ahmedabad, but the cultivators say the caterpillar is not known to the South where black soil exists. The caterpillar appears about a fortnight after the first fall of rain when the crops are beginning to grow. It attacks cotton, sesamum, pulses of all kinds, brinjal and other plants. It often makes a clean sweep of a field beginning on one side and finishing on the other. If the weather is dry, its ravages may continue for three weeks or more, but if heavy rain falls it rapidly disappears. Mr. Middleton is of opinion that in fields where the ground is smooth and not too hard, rolling frequently with a heavy roller would kill a great many of the caterpillars, but he adds that it is difficult to have the fields in this condition at the time of attack, and that his own efforts to reduce the numbers of the pest in this way have not been very successful.

For a reference to damage done by the same species in the Central Provinces, see Vol. I, p. 55 of these *Notes.* The woodcut shows the moth natural size.

Andraca trilochoides on Tea.

In January 1893 some caterpillars were forwarded to the Museum by Messrs. Jardine Skinner and Co. with the information that they had been doing a good deal of damage to tea in Cachar.

It was said that in former years these caterpillars were only noticed in the rainy season, but now they remain all the year round with the result that coolies have to be kept on at considerable expense to pick them off the bushes.

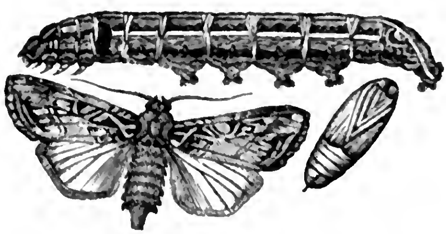
The first set of caterpillars that were forwarded to the Museum were insufficient for precise determination, but from specimens of the imago afterwards reared from caterpillars from Cachar, received on the 23rd February, the insect was identified as belonging to the species ***Andraca trilochoides***, Moore (=A. ***bipunctata***, Walker) as given by Hampson. The pupa was found to be enclosed in a rough hairy cocoon attached to the twigs.

The bushes attacked were not situated in blocks, but were scattered about amongst the tea; they were often completely denuded of leaves. The extent of the damage may be judged from the fact that upon one garden alone, during the six months ending May 1893, it was found worth while to spend some fifteen hundred rupees in picking the insects off the bushes. The result in this case was the destruction of no less than sixty-nine and a half maunds weight of caterpillars.

Chrysalids of the same species were afterwards forwarded to the Museum in September 1893 through the office of the Assistant Commissioner of Jorhat, from one of the tea gardens in that district. A moth emerged in the following month in the Museum, showing that the development of the insect goes on at such different seasons of the year as the rains and the cold weather.

Prodenia littoralis, Boisd.

A specimen of this cosmopolitan species was forwarded to the Museum in November 1893 through Mr. L. de Niceville from Herr Hofrath, Dr. L. Martin of Sumatra. The insect was said to have proved ter-



ribly destructive to young tobacco plants in the nurseries of North-East Sumatra. The species has been previously reported as injuring mulberry bushes in India. See these *Notes*, Vol. II, p. 160. The woodcut shows larva, pupa, and imago, all natural ize of a variety of the same species reared in the Museum from caterpillars found tunnelling into ***the developing shoot of a*** large lily plant in Calcutta.

Heliothis armigera, Hübn.

In January 1894 live chrysalids of an insect found feeding on *tur* (*Cajanus indicus*) were forwarded to the Indian Museum by the Settlement Officer, Chhindwara. Two moths emerged in the Museum and proved to belong to the destructive Noctuid *Heliothis armigera*, Hübn., which has been referred to in numerous places in these *Notes*. One of the chrysalids was found to be parasitized by a Tachinid related to the species *Trycolyga bombycis*, Becher, but differing from this species both in the arrangement of the frontal bristles and also in wing veining.

The following is a report subsequently forwarded by the Settlement Officer upon the subject :—

"The eggs are, I believe, laid on the under-side of the leaf, for one batch of eggs of some sort was so found, and close to them a young caterpillar, which seemed to be of the same kind as the other carterpillars infesting the plant.

"The caterpillar is smooth, soft, and either green or brown in colour. It feeds by day. It eats chiefly the pea. First it gnaws through the outer pod—a process which takes a good deal of time, about an hour. Then it inserts part of its body and eats the pea. To get into the next compartment it does not gnaw through the partition, but works from the outside again. Sometimes only one compartment of a pod is eaten into. Occasionally the leaf is eaten. The caterpillar is unusually common this year. It has been known for a long time. The cultivators are not aware of its transformations. They have observed that the appearance of the caterpillar in numbers coincides with cloudy weather. The only attempt to get rid of the caterpillars is, when the cultivator has spare time, to shake the bushes and collect the fallen caterpillars in a basket ; the caterpillars are not killed but turned out into the ground some little way from the field, so that many probably find their way to another *tur* field. The cultivators think that the caterpillars die when they disappear from the *tur* plants.

"The specimens sent are from caterpillars kept until by leaving the branches and wandering rapidly off they seemed ready to burrow. They were then allowed to burrow in earth kept in an earthen pot. Owing to the jolting of the earth in the pot and to clumsy handling the specimens may, I fear, be imperfect. The caterpillar on burrowing turns round and round, dog-fashion, until its chamber is made. The man who removed the chrysalides from the earth says that their chambers were not lined in any way."

Wheat caterpillars.

In December 1892 some caterpillars were forwarded to the Museum by the Deputy Commissioner, Betul, Central Provinces, who wrote : "They appeared in this district about a month ago and are doing enormous damage to the young wheat." The specimens proved to be Noctues larvæ, but the material was insufficient for the identification of the species.

Similar specimens were forwarded in January 1893 by the Deputy Commissioner, Chhindwara, and from these a single moth emerged in the Museum on the 27th February. The species proved to be new to the

Indian Museum collection, so was sent to London, where it has been examined by Mr. G. F. Hampson, who identifies it as *Leucania fragilis*, Butler. The following is the report furnished by the Deputy Commissioner of Chhindwara :—

Note on the Sawardehi caterpillar.—"This caterpillar has appeared in the Chhindwara District in increasing numbers for the last three years. It is said that it had not been seen before for 30 or 40 years, and the country people suppose its appearance to be connected in some way with the flights of locusts that have passed over the district in recent years. It appeared this year in large numbers in the adjoining district of Betul, but apparently nowhere else in the provinces.

"It begins operations as soon as the young wheat is out of the ground, and always attacks fields lying on the edge of jungle or waste land. Two or three, or sometimes ten or a dozen, rows of wheat are eaten clean away, but the caterpillar seldom penetrates to the middle of fields of any size. In the day time they may be found huddled together under stones and clods of earth along the edge of the field.

"As a rule they attack nothing but wheat and that only before it is in ear. I have been told of damage done by them to kutki (*Panicum psilopodium*), but have never seen a field showing signs of it.

"The damage threatened this year to be serious and the cultivators began taking defensive measures,—irrigating the edges of exposed fields, and digging pits for collecting and burning the caterpillars. But this was resented by the 'garpagaris' (professional hail averters and general medicine-men), and the damage was allowed to go on unchecked until the caterpillars were destroyed or driven back to the jungle by a heavy fall of rain in January.

"Unfortunately as soon as they disappeared the people lost all interest in them, and I have not been able to trace their further development, nor can I give any explanation of the origin of their name."

In response to further inquiries instituted through the kindness of the Commissioner of Settlements and Agriculture in the Central Provinces the following additional report, dated 18th March 1893, was furnished by the Settlement Officer, Chhindwara :—

"With reference to your letter No. $\frac{797}{126}$, dated 14th instant, forwarding a copy of a letter from Mr. Cotes, I regret to say that it seems to be impossible to obtain chrysalides. The brood has hatched out, and I can only find the cases. One specimen was found but seems to be dead.

"The scanty information gathered is as follows :—

"The caterpillar was only found on the edge of fields where the soil is shallow and comparatively dry. The chief damage was to wheat fields which adjoin a plot of stony shallow land. The caterpillar began at the edge and worked towards the centre of the field. The crop was cleared almost entirely off the ground, only a few scattered stalks remaining; the caterpillar worked by night and lay up by day in the crevices of the light soil. On the point to which Mr. Cotes attaches importance, *viz.*, whether the caterpillar is a "cut worm" or not, I regret that I can give no information of value. Neither the cultivators nor I noticed in hunting out the caterpillars any traces of fodder carried off by them to their lurking places, but the fact that untrained observers did not notice the fact does not go far to disprove the fact.

"The area cleared by the caterpillars was not as a rule large, rarely extending so much as 30 feet from the edge of the field inwards.

"The colour varied considerably, brown, green and a sort of yellow all being found The shape was the same, soft and smooth skinned.

"In most villages the pest was looked on as quite a new one, but in one or two places it was said to have occurred about three years ago. The natives were not aware that the caterpillar eventually became a moth. They said the caterpillar could not exist in moist ground and were confident that rain would stop the plague. They firmly believe that the rain which actually fell heavily (at the beginning of January) killed off the caterpillars, and the sight of the empty pupa cases does not persuade them that the insect has flown. The pupa cases are found at the edge of the growing wheat, where the caterpillars were last at work, embedded a couple of inches or so in the soil. The cases are of a transparent brown........ "

Preserved specimens of what appeared to be the same species of caterpillar were subsequently forwarded by Mr. J. S. Gamble, Conservator of Forests, Dehra Dun, who had found the wheat fields in the Upper Valley of the Tons badly attacked by it. The caterpillars were noticed to feed upon the young unripe ears, and the villagers complained much of the pest, but the inaccessibility of the locality rendered the forwarding of living specimens impracticable.

As in most species of Noctues, the caterpillars possessed few distinguishing characters, but, so far as could be made out from comparison of specimens preserved in the Museum, they would seem to be identical with what were forwarded to the Museum from Tipperah, Bengal, in November 1888 under the Native name *leda poka,* also with specimens forwarded about the same date as attacking *Horra* (Indian Millet) in the Madras Presidency. In the absence, however, of the adult specimens these identifications must necessarily be somewhat uncertain.

Leda poka insects.

Pupae, said to belong to the notorious *Leda poka* caterpillar which attacks paddy, were forwarded to the Museum in February 1894 from Backerganj, at the instance of the Director of Land Records and Agriculture, Bengal. They arrived on 22nd February and it was found that three specimens belonging to two species of Noctues moths of the genus *Leucania,* as determined in the Museum collection, had emerged on the journey. One of these belongs to the species *Leucania extrania,* Guen., already recorded in these *Notes* in connection with injury to paddy. The second species is not unlike *Leucania extrania* in general outline, but differs markedly in its considerably smaller size, its white hind wings and in the peculiar striped marking on the front wings. It is at present unnamed in the Museum collection.

Sorghum borer in Gurgaon.

Caterpillars identical with the species referred to in previous numbers of these *Notes* as the "Sorghum borer" (*Dialraea sp.*) were forwarded to the Museum in December 1893 through the Deputy Commissioner of the Gurgaon District, Punjab, with the information that the insect had done a good deal of damage to Sorghum (jowar) during the autumn in certain circles of the district. The following is taken from the note accompanying the specimen:—

"The species appears to be identical with that which forms the subject of note No. 3, Series No. I of vol. I of the Indian Museum Notes, or closely allied to that. I regret that I have been unable so far to obtain any specimens of the extra-larval stage of this pest, but will endeavour to secure the chrysalis or possibly the imago.

"With regard to the life history of this insect, I would add, as regards local observations, the following notes which I have personally verified, *viz.*:—

(*a*) The grub normally if not invariably enters the top joint of the millet stalks just above that leaf which constitutes a spathe for the developing inflorescence. In other words the plant is attacked when the flowering shoots are between bud and blossoms and the head of grain is consequently more or less arrested.

(*b*) The larva feeds upon the medullary portion of the stalk; its proper food being evidently the sugary sap which ascends within the stem of this saccharrid millet, just before flowering. The tunnelled portion of the infested stalk contains a fluffy substance which is probably composed of the rejected fibre. This and the interior surface of the tunnel in almost every stalk examined were found to be strongly tinged with red purple colouring matter which looks as if it might be derived from the action of the larval juices upon matter taken up from the substance of the plant and subsequently dejected. There is a normal tendency, however, in the upper joints especially of the jowar stalks, to take on this tinge, and it is very possible that the tinge which is conspicuous and characteristic of the infested stalks internally may be due to the admission of air as the larva burrows, and the effect of this upon the acids of the eroded vegetable tissues. Whatever may be the cause, the appearances are characteristic and unmistakeable.

(*c*) The pest attacks those local varieties of the bush millet which are most rich in saccharine elements; particularly what is known as the "green" millet (roli jowari) from the midrib of the leaves being of the same colour as the blade or slightly glareous.

"This pest has no specific local vernacular name. It is known by the generic appellation of "Bhaonri" and "Gindar" indifferently. The former is a misnomer based on a theory of the farmers that the larvæ are deposited by flying insects of the cockchafers' type (Bhaonri). The latter is of course the general name for all sorts of grubs and caterpillars."

Sugarcane borer in Gujarat.

Writing from Baroda in July 1892, Mr. T. H. Middleton refers to the great damage done to cane in Gujarat in the preceding season as in every dry year. He recommends cutting off the affected stalks as close to

the ground as possible and then destroying them. "If this were done," he adds, "as soon as the pest appeared, I think the damage done in any season would be materially lessened, for it is successive crops of larvæ rather than numbers at one attack that are to be dreaded. The two moths I kept in captivity appeared to be very sluggish, and incapable of travelling any distance. If they really are so, in districts where much cane is not grown, attacks from without would be uncommon and care on the part of the individual cultivator should do much."

Teak defoliator.

In August 1893 damage was again occasioned in the teak forests of Berar by caterpillars. The species most numerously represented in a somewhat heterogeneous set of caterpillars forwarded to the Museum through the Forest Department from Ellichpur, was *Hyblæa puera*, Cramer, which would seem to be a serious defoliator of teak. The caterpillars were first noticed on 7th June or nearly a month earlier than in the preceding year. They attacked the young leaves which were then just beginning to appear, but the extent of the damage does not seem to have been recorded.

Leucinodes orbonalis, Guen.

A moth reared from a caterpillar found boring into brinjal fruit in Baroda was forwarded to the Museum by Mr. T. H. Middleton in January 1893. It proved to belong to the species *Leucinodes orbonalis*, Guen., which has previously been recorded in a similar connection in Bengal, see these *Notes*, Vol. III, p. 99. Together with the moth Mr. Middleton forwarded a small Ichneumonid parasite which had emerged from the pupa of the same species. It proved to be unnamed in the Museum collection.

Sâl caterpillars.

In July 1893 specimens were forwarded through the Director of the Imperial Forest School, Dehra Dun, of insects reported to have attacked sâl forest in the Pilibhit Division. According to a report furnished by the local forest officer the caterpillars were first noticed in the end of April over an area which had been recently burnt. Later on they spread throughout the entire area of the Pilibhit forests and stripped a large number of trees of their entire foliage. They seemed to be almost entirely confined to sâl trees.

Amongst a somewhat miscellaneous set of insects forwarded to the Museum were found numerous Noctuid like caterpillars which are likely

to have been responsible for most of the injury. The material, however, was insufficient for the identification of the species.

Palyga damastesalis, Walker.

Two sets of caterpillars of this destructive species were forwarded in October 1893 through the Director of the Imperial Forest School, Dehra, from the Ellichpur Division, Berar. From the local report forwarded it seems that the insect has been noticed as attacking teak in Ellichpur Division for the last three years. It appears in September and October and is specially severe in pure teak forest. The forest ranger in charge of fellings Shembadolo writes:—

"There was a very severe attack last year. This year the caterpillars appeared in less numbers either owing to heavy rains after the eggs were laid or to the hailstorm while the caterpillars were undergoing their third or pupal stage last year."

Caterpillars reared by the same officer are reported to have transformed into pupæ in the early part of October, the larval stage lasting for about a fortnight.

Gelechia cerealella, Oliv.

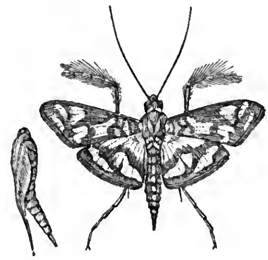
In May 1893 specimens of a minute grain moth were forwarded by the Director of Land Records and Agriculture, Lahore, with the information that they had emerged from rice of the preceding autumn crop. The pupa was noticed to be formed within the grain. The insect proved to be indistinguishable from specimens in the Museum collection, which had been reared from soft white wheat received from the North-West Provinces. On comparison with the authenticated specimens of the species *Gelechia* (*Sitotroga*) *cerealella*, Oliv., reared from maize grown in Kulu (see these *Notes*, Vol. II, p. 4.), it was found to be very considerably smaller but not otherwise distinguishable, and Mr. J. H. Durrant, to whom the insect has since been submitted, confirms the supposition that the two forms are not specifically distinct.

It may be concluded that the species *Gelechia* (*Sitotroga*) *cerealella*, Oliv., attacks alike stored wheat, rice and maize in this country. And as it is able to exist in Lahore in May it follows that the temperature of 104° F. which has been claimed by some investigators as sufficient, when continued for two days, to destroy it, can scarcely be effectual under all circumstances.

Nausinöe neptis, Cramer.

Caterpillars of this Pyralid were received in July 1893 through Mr. R. Chapman with the information that they had been brought to him as attacking the

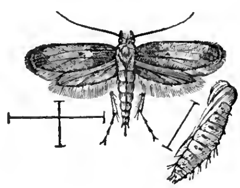
Belphul (*Jasminum sambac,* Ait.) in the neighbourhood of Calcutta. The moth emerged on 27th July.



The figure shows the moth and its chrysalis both natural size.

Tinea tapetzella, Linn.

This destructive clothes moth has been reared in the Museum from the woollen lining of a saddle. Its identity with the European form has been ascertained through the kindness of Mr. J. Durrant, who has examined the specimens



in England. The woodcut shows the moth and its pupa the natural size being indicated by hair lines.

Magiria robusta, Moore.

In June 1893 a mass of matted silk containing numerous cocoons was received through the Provincial Museum, Lucknow, from the Principal, Thomason College, Roorkee, who wrote that every toon tree in the station was covered with it from base to top. The insect was reared in the Museum and proved to be the common toon borer *Magiria robusta,* Moore, which is figured in these *Notes,* Vol. I, Plate III. The caterpillar of this species tunnels the terminal shoots of toon trees and in this way does a very large amount of damage. It habitually spins a cocoon, but the formation of a regular web would seem to be unusual.

Paddy stalk borer.

In August 1892 specimens were forwarded to the Museum by the Manager of the Hutwa Raj, Saran, through the Director of Land Records and Agriculture, Bengal, of a caterpillar known locally as *chhupta* which had proved injurious to paddy. The specimens arrived in too poor a state of preservation for precise determination, but they were either identical with, or very closely allied to, the paddy stalk borer (*Chilo sp.*) referred to in these *Notes*, Vol. II, p. 19.

Similar specimens were forwarded about the same date, by the Acting Deputy Superintendent, Konkan Revenue Survey, through the Director of Land Records and Agriculture, Bombay. In this case the insect was said to have appeared in the month of July and to have been specially injurious in the neighbourhood of the coast.

In September 1893 similar specimens were forwarded by the Director of Land Records and Agriculture, Bengal, from the Orissa Division with the information that they were known as *Gundira* and had been causing damage to the standing paddy crops in the Tributary State of Killa Nursinghpur.

In the early part of October 1893 again, similar stem borers were forwarded through the same channel from the Dacca District. In this case the insect was said to have been damaging the *Aman* crops in parts of the Munshigunj sub-division where some three or four hundred bighas of land were affected.

To enable the imago to be reared for specific identification a good large supply of affected paddy stalks should be carefully cut and forwarded to the Indian Museum by mail direct so that the insect may arrive alive.

Boarmia sp.

Moths reared from caterpillars found feeding upon Teak and Eucalyptus trees in Dehra Dun were furnished by the Director of the Imperial Forest School in October 1892. One of the specimens was found to be identical with a moth in the Indian Museum collection determined by Colonel Swinhœ as *Boarmia trispinaria*, Walker. It may be noticed that the series presented so large a range of individual variation as to include forms hitherto looked upon as distinct species in the same genus. These will no doubt eventually have to be brought together as varieties of some central type.

Cotton caterpillars.

In September 1893 some Lepidopterous larvæ were forwarded by the Assistant Director of Land Records and Agriculture, Cawnpore, with the information that they had proved very destructive to Egyptian cotton on the Experimental Farm. It appears that the insect attacked the leaves causing them to curl and dry up, the result being that the plants entirely refused to flower. The specimens proved insufficient for precise determination but are likely to have belonged to the group Noctues.

Mustard caterpillars.

Noctues caterpillars insufficient for precise identification, but likely to have the habits of cut worms were forwarded to the Museum in March 1893 through the office of the Director of Land Records and Agriculture, Bengal, with the information that they had proved injurious to mustard plants in Berhampore. No further particulars could be obtained.

Paddy caterpillars in Assam.

In November 1893 caterpillars were forwarded by the Director of Land Records and Agriculture, Assam, with the information that they had been reported as having done considerable damage to the paddy crop in the Kamrup district. The specimens proved to be Lepidopterous larvæ probably belonging to the group Noctues, but the material was insufficient for precise identification.

Deodar cone moth.

Cones of Deodar (*Cedrus Deodara*) attacked by caterpillars were forwarded through the Imperial Forest School, Dehra, from the Kulu division, in July 1892. The material proved insufficient for specific identification, but the insect is likely to be one of the Microlepidoptera.

Potato cut worm.

In connection with injury to potato plants from cut worms, a chrysalis was forwarded to the Museum in the early part of 1893 by Babu N. G. Mukharji from Berhampore. The specimen arrived on the 19th February. The moth emerged eight days afterwards and was found to belong to the species *Prodenia littoralis*, Boisd., which has previously been reported in connection with injury to mulberry bushes in Balasore.

Safflower caterpillars.

In December 1892 caterpillars were forwarded to the Museum from the Superintendent, Government Farms, Nagpur, with the information that they had to a large extent spoilt the safflower crop. The specimens were insufficient for the precise determination of the species but are likely to be the larvæ of one of the Noctues moths related to, but distinct from the species *Heliothis armigera*, Hübn.

Cabbage Tenthredinid in Baroda.

Tenthredinidæ larvæ were forwarded in January 1893 by Mr. T. H. Middleton with the information that they do great damage to cabbage seedlings and other Cruciferæ cultivated in Baroda. The insects arrived alive but the attempt that was made to rear them upon cabbage leaves in Calcutta proved unsuccessful, so the identity of the species could not be ascertained.

Acridium peregrinum, Oliv.

The account given in these *Notes*, Vol. III, pp. 77 to 86, of the locust invasion of 1889—92 brings the history of the locust *Acridium peregrinum* in India up to the early spring of 1892. Since then the insect has been present in small numbers but no appreciable damage seems to have been occasioned by it. The following is the information which has reached the Indian Museum.

In a report, forwarded by the Director of Land Records and Agriculture, Bombay, from the Upper Sind Frontier District the presence of locusts is recorded on the 26th May 1892 in the Shahdadpur Taluka. The specimens which accompanied the report were adults of the species *Acridium peregrinum*, Oliv., in poor preservation.

Similar specimens were forwarded in November 1892 by the Deputy Commissioner, Shahpur, with the information that they had appeared in the September previous.

The following is a report, dated 6th October 1892, by the Deputy Collector, Upper Sind Frontier, forwarded by the Director of Land Records and Agriculture, Bombay. It was accompanied by adult specimens in poor preservation of the species *Acridium peregrinum*, Oliv. :—

"I have the honor to submit herewith report No. A., dated the 5th instant, together with specimens of locusts enclosed in a bottle received from the Mukhtiarkar of Kashmor.

"It would appear from the report that a large swarm of locusts has appeared in the North-Western part of Taluka Kashmor is doing damage to the Kharif crops in Dehs.

Labri, Dambki, Alamabad, Chil-Rahamatabad and Jagirabad. From report No. 26651, dated the 2nd instant, sent by the Mukhtiarkar of Thul direct to your office, also, it appears that a small swarm of locusts appeared in his taluka, on the 1st instant, and did some damage to the crops on the northern side of the Desert Canal for about two hours and then went away into the Kelat territory."

Further specimens of the same species were forwarded to the Museum in October 1892 by the Deputy Commissioner of Rawalpindi who referred to them in his letter, dated 22nd October 1892, as having "now" visited the district.

The next reference to the insect was in the form of specimens forwarded to the Museum from an Amballa Tahsildar with the information that they had passed through five or six villages in that neighbourhood on the 24th November 1892 but had done no damage. Similar specimens were also forwarded by the Deputy Commissioner of Amballa on the 12th January 1893.

From Jhang also specimens were forwarded by the Deputy Commissioner on the 23rd January 1893 with the information that they had "been lately visiting Tahsil Shorkot in this district."

Specimens have also been forwarded to the Museum by the Deputy Commissioner, Amritsar (forwarding letter dated 19th October 1892), by the Deputy Commissioner, Dera Ghazi Khan (forwarding letter dated 2nd November 1892), by the Deputy Commissioner, Gurgaon (forwarding letter dated 28th November 1892), and by the Director of Land Records and Agriculture, Punjab, from the Dera Ismail Khan district (forwarding letter dated 26th June 1893). In these cases, however, the dates of appearance have not been furnished.

Hieroglyphus furcifer, Sauss.

In the autumn of 1892 the Acridid *Hieroglyphus furcifer*, Sauss., as determined in the Indian Museum collection, was prevalent in both the Bombay, Deccan and in the Madras Presidency. It seems to have occasioned a good deal of damage of a local nature to crops.

In the Poona district the insect was first noticed on the 23rd August about which time the larvæ are said to have hatched out from eggs laid in the fields. The damage to *jowari* in one village is reported to have been considerable, but information has not been received as to the extent of the area affected. The only measure attempted for dealing with the pest seems to have been that of catching and killing the insects

by hand. The identity of the species was ascertained from specimens forwarded to the Indian Museum in September 1892 through the Director of Land Records and Agriculture, Bombay.

In Belgaum district the insect appears to have attacked paddy. Its identity was ascertained from specimens forwarded in October 1892 through the Director of Land Records and Agriculture, Bombay. The following is an extract from a report, dated 31st October 1892, furnished by the Collector of Belgaum :—

"An account of their production is given thus as stated by villagers. As soon as rice crops are cut, the insects each lay in the cracks of the field six or seven eggs at a time resembling in shape the seeds of cucumber and then die. They breed only once a year. About six months afterwards, each egg hatches out about 40 or 50 young about the size of poppy seeds.

"Owing to such a rapid production the number of these insects is increasing every year, and crops are becoming affected to a certain extent. The ryots are unable to suggest any remedy."

In the Kurnool district the insects were reported as "locusts" in August 1892. The identity of the species was ascertained from larvæ forwarded through the Central Museum, Madras. The following is an extract from a report, dated 8th September, by the Collector of Kurnool furnished by the Board of Revenue, Madras :—

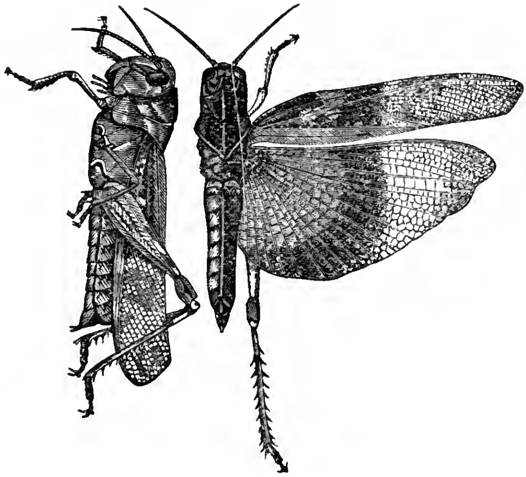
"I have the honor to state that the Tahsildar of Markapur reports that a swarm of locusts appeared in the week ending 20th ultimo, in the fields of Satakodu and its hamlet Akkupalem in the Markapur Taluk and ate away the leaves of Jonna, Korra and Sajja crops over an extent of about 60 or 70 acres, that no damage has resulted, and that the subsequent rains must have mostly destroyed the insects."

Writing on the 20th October the Collector added that the plants had recovered and that no trace of the attack was visible.

In the Chingleput district, as appears from reports forwarded by the Board of Revenue, Madras, the Sub-Collector reported the destruction by locusts of some four hundred acres of crops. This occurred in the early part of October 1892. From the description given of the gradual growth of the insects from the time when they were "very small in size like flies" it would seem that they had developed from eggs laid upon the spot. Subsequent reports were afterwards forwarded from other parts of the district showing that the insects were somewhat widely prevalent though no very striking damage was brought to light. The identity of the species was ascertained from specimens forwarded to the Central Museum, Madras, which were found to comprise both larvæ and adults of the Acridid.

Œdalus marmoratus, Linn.

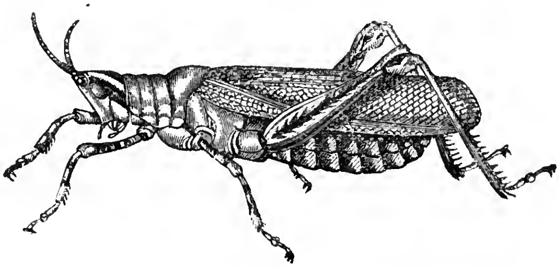
In December 1893 specimens were forwarded by the Director of Land Records and Agriculture, Bombay, of an insect reported to have done injury to young bajri (*Pennesetum typhoideum*) crops in the Nasik district. The



insects proved to belong to the species *Œdalus marmoratus*, Linn., as determined in the Indian Museum collection.

Pœcilocera picta, Fabr.

Specimens of the Acridid *Pœcilocera picta*, Fabr., as determined in the Indian Museum collection, were forwarded in July 1893 by the Deputy Commissioner of Shahpur. According to the report furnished, the insect was



sluggish and non-migratory: it was found only on the *Akk* plant (*Calotropis procera*) which the migratory locust rarely touches; in life

its colours were brilliant blue, green and yellow. Similar specimens were forwarded in the same month by the Director of Land Records and Agriculture, Bombay, from the Assistant Political Agent, Sorath Prant. The insect has previously been sent to the Indian Museum as injuring young crops in Kathiawar but little is known about it. The woodcut shows the insect natural size.

Oxya velox, Burm.

In October 1893 specimens of the Acridid *Oxya velox*, Burm., as determined in the Indian Museum collection, were forwarded by the Deputy Commissioner, Peshawar, with the information that the insect had been prevalent both in the Peshawar District and also in the neighbouring hill tracts. It was reported as having done extensive damage to crops, and especially to young cotton and maize as they appeared above the ground.

Epacromia dorsalis, Thunb.

Specimens of insects reported as locusts in the Dera Ismail Khan District, Punjab, were forwarded in October 1892 by the Deputy Commissioner. They proved to belong to the species *Epacromia dorsalis*, Thunb., as determined in the Indian Museum collection. The species has previously been reported as attacking crops both in the Upper Sind Frontier District and in Ganjam, so no doubt occurs throughout India.

The figure shows the insect natural size.

Acrididæ in Tinnevelli.

In July 1892 some damage from Acrididæ was reported in the Tinnevelli district. In a report received through the Board of Revenue, Madras, the Collector of Tinnevelli writes:—

"I have the honor to forward a bottle received from the Tahsildar of Serivilliputur containing specimens of a species of grasshopper. He reports that these insects have appeared in certain villages of his taluk, where in several places they have been found to injure the young ragi crops. The damage is as yet but slight."

Specimens were afterwards received through the Government Central Museum, Madras. They were found to comprise the following species, as determined in the Indian Museum collection:—

(*a*) *Acridium æruginosum*, Burm., thirteen specimens.
(*b*) *Crotogonus trachypterus*, Blanch., three specimens.
(*c*) *Œdalus marmoratus*, Linn., two specimens.
(*d*) *Catantops indicus*, Sauss., two specimens.

According to a subsequent report by the Collector, furnished by the Board of Revenue, Madras, the insects made their first appearance about the 20th May, and a week later were found in twelve villages. They disappeared before the end of July. Writing on the 2nd July the Collector observes:—"They occur as ova, wingless larvæ and fully developed insects. The damage to the crops is said to be as yet but slight, but cannot, the tahsildar reports, be estimated before the harvest."

The specimens furnished through the Madras Museum in connection with this report comprised the following species as determined in the Indian Museum collection:—

(*a*) *Œdalus marmoratus*, Linn., eighteen adults.
(*b*) *Oxya velox*, Burm., fifteen adults.
(*c*) *Pachytylus cinerascens*, Fab., one adult.
(*d*) *Crotogonus trachypterus*, Blanch., one adult.
(*e*) *Tryxalis turrita*, Linn., twenty-seven specimens including both adults and larvæ.

Under these circumstances it would appear that the damage was due rather to multiplication of numerous local forms than to special incursion by migratory locusts.

Acrididæ in Madura.

Injury from Acrididæ was reported in the Madura District in August 1892. The following is an extract from a local report upon the subject forwarded by the Collector of Madura, and dated 26th August 1892.

It has been furnished by the Board of Revenue, Madras:—

"The Deputy Collector, Madura Division, reports that locusts appeared in several villages in his division and have already committed mischief to ragi and

cumbre crops sown, though the same would be appreciable if they increase in numbers and continue. In Imimangalum Taluk, the locusts that appeared are said to be ordinary ones, about an inch in length and to have sprung up all at once in swarms in some of the villages and commenced to damage the crops by devouring the tender green leaves. They gradually disappeared with subsequent rain and wind and no material damage has been done to the crops. From the report of the Deputy Collector, Melur, it appears that the locusts had hidden themselves in the clefts or openings in the fields, during the late rain and wind, and to have re-appeared afterwards, and that the crops damaged by them have survived after their gradual disappearance. In Pemjakulam Taluk the locusts are reported to have appeared in some villages and damaged cholum and ragi crops on dry lands and to be gradually disappearing. In Manamadura Taluk of the Sivagunga Zemindari, the insects are said to have destroyed about 150 (illegible?) of land cultivated with ragi crops and to have disappeared with the rains. One particular feature is, that these locusts do not commit any damage to the crops that have once escaped their attack. The insects have not appeared in any other parts of the district. These locusts are probably only grasshoppers; they rise under your horse's feet by hundreds in grass of tank beds."

The first set of specimens, forwarded through the Central Museum, Madras, in September from the Madura District, in connection with the above, comprised only larvæ in poor preservation of a species of Acrididæ thought to belong to the genus *Epacromia*. Subsequent consignment comprised the following as determined in the Indian Museum collection.

From the Periakulam Taluk, Madura District:—

(*a*) *Acrida turrita*, Linn., large variety, thirty specimens.
(*b*) *Acrida turrita*, Linn., small variety, ten specimens.
(*c*) *Oxya velox*, Burm., twenty-three specimens.
(*d*) *Atractomorpha crenulata*, Fabr., fourteen specimens.
(*e*) *Euprepocnemis*, *sp.*, thirteen specimens.
(*f*) *Epacromia ? tricoloripes*, Burm., five specimens.
(*g*) *Pachytylus cinerascens*, Fabr., two specimens.
(*h*) *Catantops indicus*, Sauss., two specimens.
(*k*) *Acridium æruginosum*, Burm., one specimen.

From the Tirumungalum Taluk, Madura District:—

(*a*) *Crotogonus trachypterus*, Blanch., one hundred and six specimens.
(*b*) *Œdalus marmoratus*, Linn., four specimens.
(*c*) *Catantops indicus*, Sauss., four specimens.

Acrididæ in Poona.

In August 1893 the following Acrididæ were forwarded from Kirkee, Poona, by Mr. J. Mollison with the information that they had been doing a good deal of damage in a plot of wal (*Dolichos lablab*). The names of the species are given as determined in the Indian Museum collection:—

(*a*) *Euprepocnemis*, sp., five specimens.
(*b*) *Tryxalis turrita*, Linn., one specimen.
(*c*) *Acridium æruginosum*, Burm., one specimen.

(*d*) *Pachytylus cinerascens*, Fabr., one specimen.
(*e*) *Œdalus marmoratus*, Linn., one specimen.
(*f*) Three larvæ not determined.

Acrididæ in the Madras Presidency.

In August 1893 the following Acrididæ were forwarded to the Indian Museum through the Central Museum, Madras. Details of the damage occasioned by them were not furnished but a reference was given to the Proceedings of the Board of Revenue, Madras, No. 4223 Mis., dated 15th July 1893. The names are given as determined in the Indian Museum collection:—

(*a*) *Acridium æruginosum*, Burm., eight specimens.
(*b*) *Catantops indicus*, Sauss., three specimens.
(*c*) *Acrida turrita*, Linn., one specimen.

Acrididæ in Bellary.

In September 1893 two sets of Acrididæ comprising the species *Epacromia dorsalis*, Thunb., *Œdalus marmoratus*, Linn., and *Crotogonus*, *sp.*, all collected by the Tahsildar of Bellary were forwarded to the Indian Museum through the Government Central Museum, Madras. The insects had been obtained at the instance of the Board of Revenue, Madras, through the Collector. No special injury by them seems to have been noticed, but the matter is recorded as showing the specific identity of the grasshoppers at that time prevalent in Bellary. The names are given as determined in the Indian Museum collection, the species being all such as are occasionally destructive to crops in India.

Acrididæ in the Punjab.

In September 1893 a number of Acrididæ were forwarded through the Imperial Forest School, Dehra, from the Chenab division in the Punjab, with the information that they destroyed young seedlings of Robinia by nipping them off at the base. The specimens were found to comprise five species of Acrididæ of which the following have been identified:—

Epacromia dorsalis, Thunb., *Crotogonus trachypterus*, Blanch., *Œdalus marmoratus*, Linn., and (?) *Acrotylus*, *sp.* The names are quoted as determined in the Indian Museum collection.

Locusts in the Central Provinces.

In June 1893 reports were forwarded to the Museum by the Commissioners of Settlements and Agriculture, Central Provinces, from the Balaghat, Chhindwara and Chanda districts which were visited by flights of locusts in the latter part of May 1893. The

insects passed over Chhindwara on 24th May. They appeared to be coming from the north-east, and going towards the south-west. They were reported at Lalbarra in the Balaghat District on the 25th May, and were then said to have come from the Seoni District. They were seen at Armori in the Chanda District on the 29th May, and are referred to as again passing over Chhindwara on the 30th May. No special damage was reported, so the flights were probably small ones. No specimens were forwarded, so the identity of the insect could not be ascertained.

Schizodactylus monstruosus, Drury.

From specimens forwarded by the Commissioner of the Patna Division in August 1892 the identity of the cricket *Schizodactylus monstruosus*, Drury, as determined in the Indian Museum collection, with the insect known as *Bherwa* in the Indigo planting districts, has at last been definitely ascertained. According to the local reports the insect occasions much damage to young crops and especially to indigo by biting through the roots. The only remedy attempted seems to be that of flooding the crop and even this is said to be only temporarily effective.

Gryllodes melanocephalus, Serv.

Damage to young juar crops by insects was reported in July 1892 by the Deputy Commissioner, Upper Sind Frontier. Specimens of the insect were forwarded through the Director of Land Records and Agriculture, Bombay. They prove to belong to the species *Gryllodes melanocephalus*, Serv., as determined in the Indian Museum collection.

Cricket injurious to Tea.

Through the Director of Land Records and Agriculture, Assam, were forwarded to the Museum in July 1893 some larvæ of a cricket said to have proved injurious to tea plants in the Jorhat District. The specimens had been furnished by Mr. H. Morison, who wrote that the insect did much damage in nurseries at night by cutting the young plants off level with the ground. The creature was observed to be specially abundant on sandy soil. It makes burrows from nine to eighteen inches deep in the ground, where it conceals itself during the day time. In the evening it sits at the mouth of the hole and may be recognized by its shrill piping. The species appears to be *Brachytrypes achatinus*, Stoll., as determined in the Indian Museum collection by Dr. Henri de Saussure.

Crickets in Comilla.

In June 1893 specimens were forwarded to the Museum through the Calcutta Agricultural and Horticultural Society of a cricket reported as causing serious damage to jute and rice crops in Comilla. The specimens forwarded were found to be immature, but they are likely to belong to the species *Brachytrypes achatinus*, Stoll. (Family Gryllidæ), as determined in the Indian Museum collection.

Mole cricket in Quetta.

A mole cricket of the genus *Gryllotalpa* was forwarded to the Museum in September 1893 by Major G. Gaisford with the information that it had proved destructive in potato fields in Quetta. In one case it was said that a plot of potatoes had been systematically sprayed every week from the time the plants were six inches high until they came into flower with London purple, but the crop was destroyed all the same by the insect.

Orthoptera in the Upper Sind Frontier District.

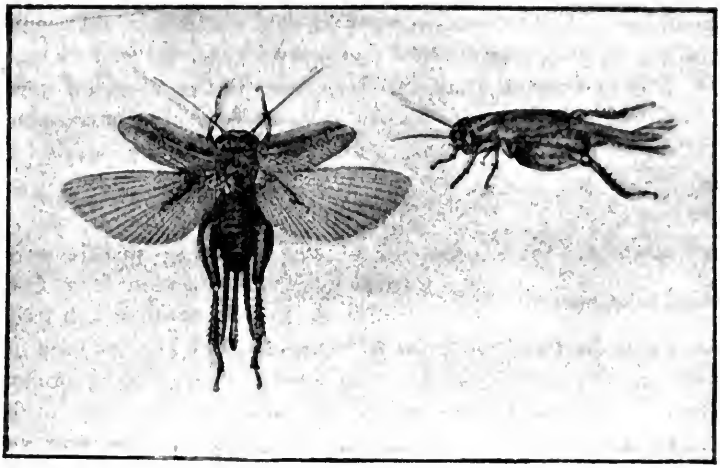
In June 1892 a number of Orthoptera were forwarded to the Museum by the Director of Land Records and Agriculture, Bombay, from the Upper Sind Frontier District. The insects were reported to have been damaging young crops of juar (great millet) in the Jacobabad and Shahdadpur taluks. The specimens comprised the following species as determined in the Indian Museum collection.

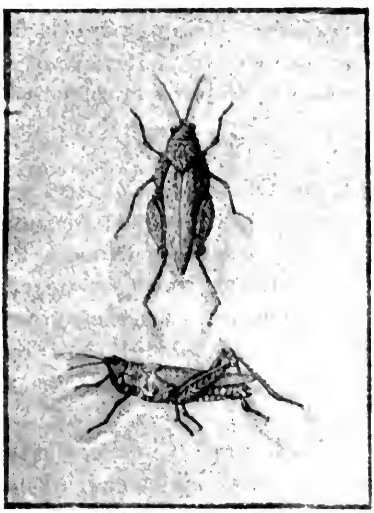
(*a*) *Chrotogonus trachypterus*, Blanch., three larvæ.
(*b*) *Gryllodes melanocephalus*, Serv., eight adults and one larva.
(*c*) *Epacromia*, sp., eleven adults comprising two allied forms, one of which is probably *E. dorsalis*, Thunb.

Determination of Orthoptera.

The cricket referred to in these *Notes*, Vol. III, p. 100, as attacking bajra, jowar, cotton, and other crops in Shahpur, where it is known locally as *Toka* has been kindly examined in Switzerland by Dr. Henry de Saussure, who identifies it as belonging to the species *Gryllodes melanocephalus*, Serv. The Acridid referred to on the same page as known in Shahpur

as *Tiridda* has also been identified by the same Entomologist as *Chrotogonus trachypterus,* Blanch.





Red velvety mites.

Further information of an interesting nature has been furnished by the District Forest Officer Buldana, Hyderabad Assigned Districts, in connection with the medical virtues, noticed on page 26 of the first number of this

volume, as ascribed to the large red velvety mite (*Tetranychus sp.*) It seems that this mite is known locally in the Hyderabad Assigned Districts as *Deogai.* It appears about the commencement of the monsoon in June and is said to be used in cases of cold and cough, "for administering internally to children, with one or two betel leaves to keep them warm." The specimens that were forwarded to the Museum were preserved in a curious red powder known as *kupu* formed of a compound of turmeric, lime juice, and borax, which is used by the people for this purpose.

Poona forest insects.

In September 1893 specimens of the following insects were forwarded by Mr. F. Gleadow from Poona.

(1) A Pyralid moth which frequents *Bambusa vulgaris, Dendrocalamus strictus,* etc., but has not been noticed as occasioning any great damage. The species proved to be unnamed in the Indian Museum collection, so was forwarded to England for examination by Mr. G. F. Hampson, the able author of the first volume upon Moths, in the series of the *Fauna of British India.* Mr. Hampson has since identified the insect as *Botys cœlesalis,* Wlk. = *vinoralis,* Wlk. = *itemalesalis,* Wlk. = *strenualis,* Wlk. = *interpesalis* =, Wlk.

(2) A Chrysomelid beetle belonging to the species *Calopepla leayana,* Latr., as determined in the Indian Museum collection.

The insect was reported as cutting unsightly holes in the leaves of the Shivan tree (*Gmelina arbona*) but was not noticed as doing any great damage. It was said to be black in colour with red markings.

Bamboo insects.

In November 1892 the Officiating Conservator of Forests, Hyderabad Assigned Districts, reported that considerable damage had been done in the Melghat Forest by a boring insect which destroyed the tops of bamboo (*Dendrocalamus*) shoots, thereby arresting their growth. Specimens were forwarded to the Indian Museum through the Director of the Imperial Forest School, Dehra Dun. They comprised the following insects as determined in the Museum collection:—

(1) *Estigmena chinensis,* Hope (Chrysomelidæ), two adults.
(2) Coleopterous larvæ, two specimens, likely to be the immature form of No. (1).
(3) Indeterminable Microlepidopterous larvæ, two specimens.

Injured bamboo shoots were afterwards forwarded. The thicker portion of the stems had been tunnelled by some insect which may not improbably have been the Microlepidopterous larvæ noticed above. The

tunnels however seemed insufficient to account for the death of the shoots. From a report subsequently furnished by the forest ranger the damage would seem to have been chiefly due to the eating away of the leaves at the top of the shoots by the Chrysomelid.

Garruga pinnata pests.

In May 1893 specimens of the fruit of *Garruga pinnata*, Roxb., attacked by insects were forwarded to the Museum from Poona by Mr. Marshall Woodrow. The fruit was found to be tunnelled by numerous small Microlepidopterous caterpillars. Galls also were furnished which contained the remains of a species of Psyllidæ. The caterpillars were reared in the Museum, the moth emerging on 26th May. It proved to belong to the species *Conogethes punctiferalis* Guén (Pyrales) as determined in the Indian Museum collection. The Psyllid proved to be new to the Museum collection so was submitted to Mr. G. B. Buckton, in England, who describes it on pp. 18 and 19 of these *Notes* as a new species of *Phacopteron* which he names *P. lentiginosum*.

Potato pests in Sind.

In March 1893 the Assistant Collector, Shahbander Division, Karachi District, Sind, reported injury by insects to experimental plots of potatoes. Specimens of the suspected insects reached the Museum through the Department of Land Records and Agriculture, Bombay, after they had been submitted to the Superintendent of Farms, Bombay, who was able to confirm the fact from his own observations elsewhere in the Bombay Presidency, that both species are destructive to potatoes. The most injurious form was a caterpillar which cuts the stalks close to the ground at night so that they are found drooping in the morning. The pupa furnished was insufficient for the precise identification of the species but no doubt belongs to one of the Noctues moths. The second insect was represented by immature specimens insufficient for absolute certainty in specific identification, but likely to belong to the species *Liogryllus bimaculatus*, De Geer as determined in the Indian Museum collection.

Notes from the N.-W. Himalayas.

The following insects, as determined in the Indian Museum collection, were forwarded in July 1893 by the Director of the Imperial Forest School, Dehra Dun, from the forests of the North-West Himalayas:—

(1) Specimens of the Cantharid beetle *Cantharis antennalis*, Marseul, found eating the leaves of *Lonicera angustifolia*

and *L. quinquelocularis.* The insects were taken on 16th June at Deoban, N.-W. Himalayas.

(2) Specimens of the Scutellerid *Scutellara nobilis*, Fabr., found feeding on the leaves of *Casearia tomentosa* at Kalsi on the Chakrata Road, Dehra Dun.

Indian silk insects for Queensland.

In compliance with a request made to the Trustees of the Indian Museum by the Government of India assistance has been given in an attempt to furnish the Government of Queensland with live stock for the introduction of the various semi-domesticated silk insects cultivated in India. In the case of the *tusser* (*Antheræa mylitta*, Drury) live cocoons were furnished through the kindness of Mr. E. F. Keighly of Ghatal and forwarded in some excellent cases designed for the purpose by Mr. R. Chapman who was at the time in charge of the current work of the Entomological Section. The first set proved a failure, but subsequent consignments arrived in better condition, and on 5th May 1893 the Under-Secretary, Department of Agriculture, Brisbane, wrote that the moths were cutting out well, and that a fair supply of impregnated eggs had been secured.

In the case of the *Eri* (*Attacus ricini*, Boisd.) and the Muga (*Antheræa assama*, Westw.) the furnishing of specimens was undertaken in consultation with the Indian Museum by the Department of Land Records and Agriculture, Assam. Several consignments of newly formed Eri cocoons were forwarded through the office of the Deputy Commissioner of Kamrup, and after some failures, the insect being an extremely difficult one to send alive owing to the shortness of the period it passes in the pupal stage, success seems to have been obtained. Under the date 1st July 1893 the Under-Secretary, Department of Agriculture, Brisbane, Queensland, wrote:—

"I have the honor to advise the receipt of one case containing 'Eri' cocoons, which came to hand in apparently good condition. None of the moths had cut out in transit and I hope we shall be able to conduct a successful experiment."

In the case of the *Muga*, which is equally difficult to forward, notice has been received from the Deputy Commissioner of Kamrup of the despatch of three sets of live cocoons (the third being forwarded 3rd November 1893), but intimation has not yet reached the Museum of their arrival in Australia.

An experiment with London Purple.

The following report, dated 9th December 1892, by the Acting Principal, Madras College of Agriculture, to the Board of Revenue, Madras, has been received through the Government Central

Museum, Madras. The London Purple and force pumps experimented with are those referred to in these *Notes*, Vol. III, p. 50.

"With reference to Board's Memo. (R. S. L. R. and A.) No.1271, dated 4th August 1892, I have the honor to herewith submit a report on an experiment with London Purple which was conducted on the Farm at the end of October last, and to request that you will be so good as to transfer the same to the Board.

"On October 21st the paddy (Sirumani and Chinna Samba) growing in the fields near the Huzur Cutcherry was found to have been attacked by an insect known in Tamil as 'Urupuchi.' This insect, which is apparently the grub of a small butterfly, is of a whitish color, from ¾ to 1 inch long, about ⅛ inch in diameter and is provided with strong mandibles. It doubles the blade on itself by means of a web and thus forms a sort of nest. The grub is said to be unable to bear the heat of the sun and consequently during the day time lies idle in its nest, but at other times it feeds on the neighbouring blades.

"All the affected fields, except one, were treated according to the native method (hereafter described) of dealing with this particular insect and in a very short time the grubs were got rid of without much damage—if any at all—to the paddy.

"The application of *London Purple* was tried on a field (area=357 acres) situated to the east of the road leading from the Government Slaughter-House to the Huzur Cutcherry. The paddy here had been transplanted on September 27th and was about 20 inches in height. On October 26th, the crops were sprayed with a solution of 1lb. of purple in 48 gallons of water, this being done according to the instructions (copy enclosed)[1] given on the tins of purple supplied to me. One tin (1lb) was thus used, the spraying being done with a force pump. The solution seemed to be sufficiently and evenly distributed over the crop. The insects, however, were not in any way affected by the application, for the spray did not reach the lower portions of the plants, which alone were attacked by the grub. On October 29th another spraying (1lb in 48 gallons) was given with an ordinary watering can, but with no better results than before. On October 30th it was feared that the crop would be lost. I therefore ordered the native method to be tried, and in a few days the insects were exterminated. The rainfall (collected at 8 A.M.) between October 26th and October 31st, was as follows:—

October	26	0·38	inches.
,,	27	0·37	,,
,,	28	1·35	,,
,,	29	*Nil.*	,,
,,	30	0·04	,,
,,	31	*Nil.*	,,

It will be noticed that, though the first spraying may have been washed off by rain, the second one was followed by dry weather.

"The native method referred to above is as follows: The bunds are thoroughly repaired and the field flooded. Cycas branches and milkhedge are dragged across the

---

1 London Purple; directions for use. The best method is with water. Mix the "London Purple" into a smooth paste, then add water in the proportion of 3 gallons to 1 ounce or 48 gallons to 1lb of "London Purple." Stir well and apply by sprinkling with a whisk or fine watering pot, taking care not to deluge the plants but only to cover them with a fine spray. * * * *

These proportions are the strongest that should be used, and care is taken, a much dilute mixture may be used with equal advantage.

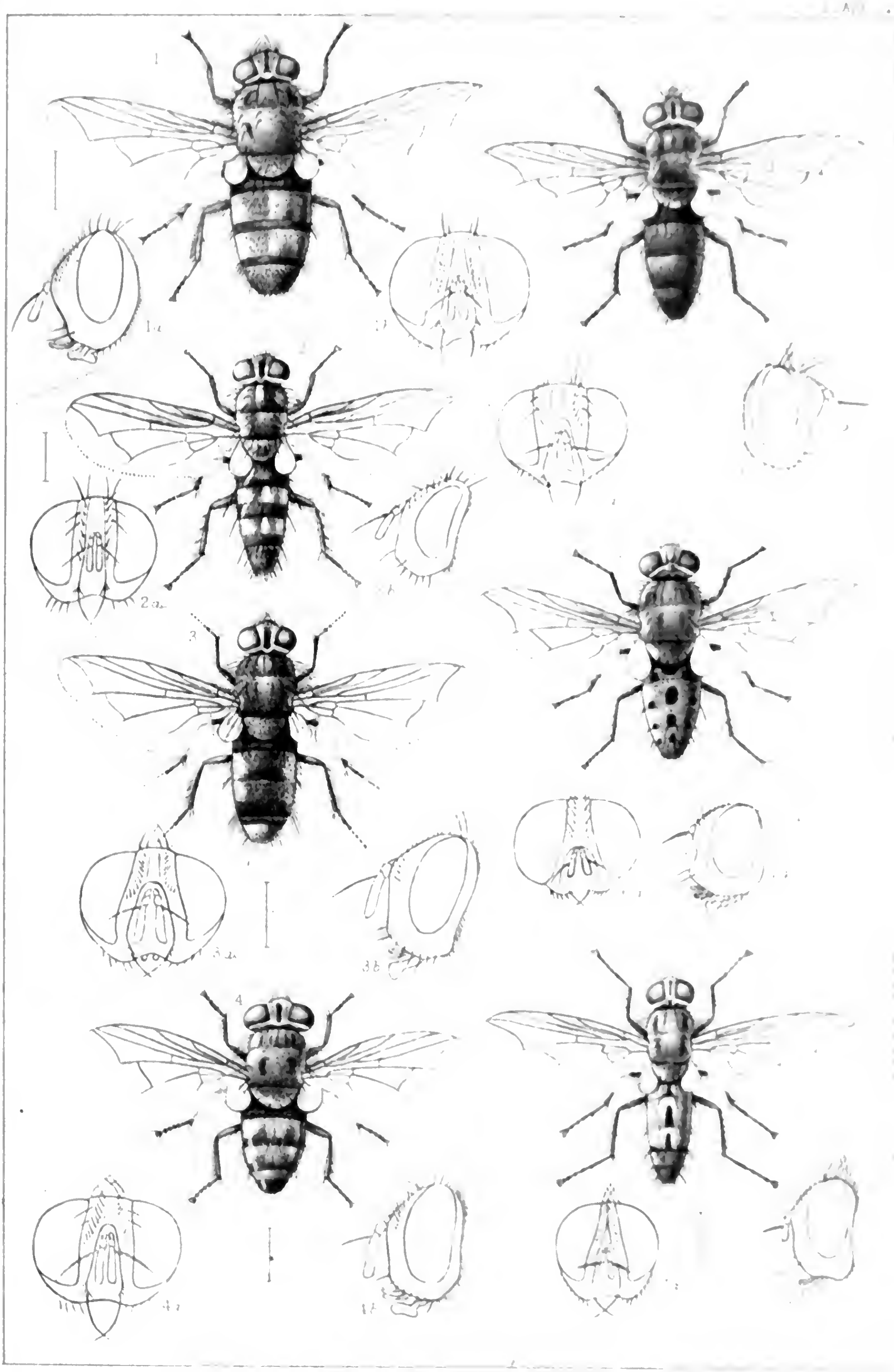
field, so as to cause the plants to lie at an angle of about 45° with the horizon, thus enabling the water to cover about half the plant including the nest before alluded to. I am informed that during the process of dragging the milkhedge some of the juice of this plant dissolves in the water and affects the insects in some way, but as far as I could see, the insects were regularly drowned, and the addition of a little milkhedge juice to the water would not, I think, make much difference. The water is allowed to remain in the field for a whole day and is then drained off. Large Cycas branches are planted in the field, but the reason for doing this does seem clear. The native method of dealing with the insect in question appears to me to be quite efficacious and it has the further advantage of not requiring the purchase of London purple, pump, etc.

"The application of London purple in the present case seemed to do no harm whatsoever to the insect, for the spray never reached either the nest or those parts of the plant eaten by the insect, and I fail to see that any system of spraying could distribute the solution low enough to affect the grub."

Errata.

In these *Notes*, Vol. III, p. 25, line 34, for "Mr. J. Sinclair," read "Mr. W. F. Sinclair." In Vol. III, p. 16, line 15, for "*Solanum Melongena*" read "*Solanum tuberosum.*"

G. I. C. P. O.—No 218 D. R. & A.—14-11-94—1,025.



1. CHRO... ..C..MIA BISERIATA
2. LEMOT.CU... TRIGIPENNIS
3. MA...CERA CASTANEA
4. MASICERA DASYTHRAE
5. MASICERA ...NSTRA
6. MINT... GRAMMA ... ...NCTATA
7. ...CAL...ERIA ... ...AMPAE

Ph... [illegible] ...s by F. M. Van der Wulp ... [illegible]

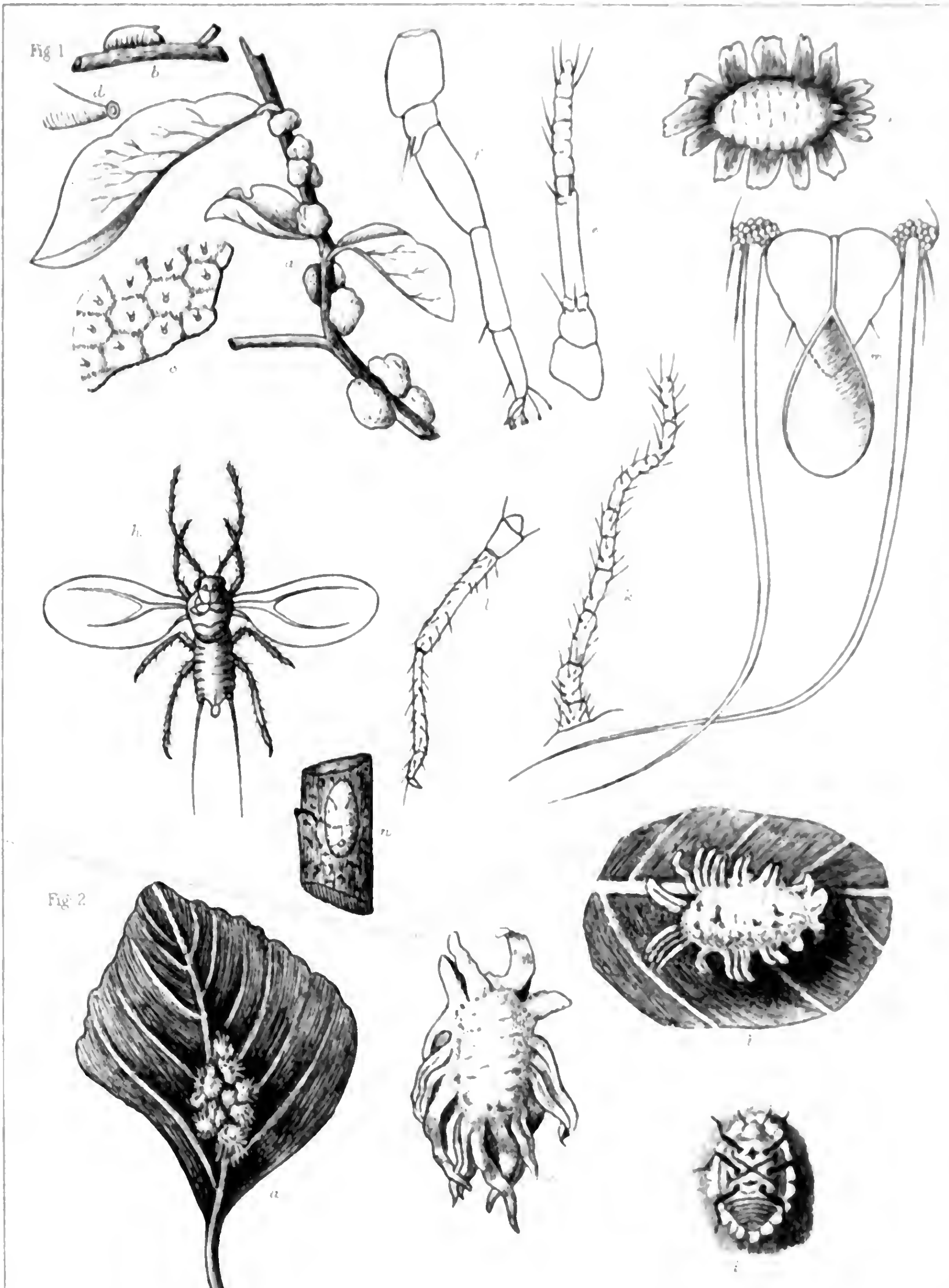


FIG 1 CEROPLASTES [illegible] FIG 2 [illegible] AE[illegible]

Photo etching from the Original Drawings [illegible]

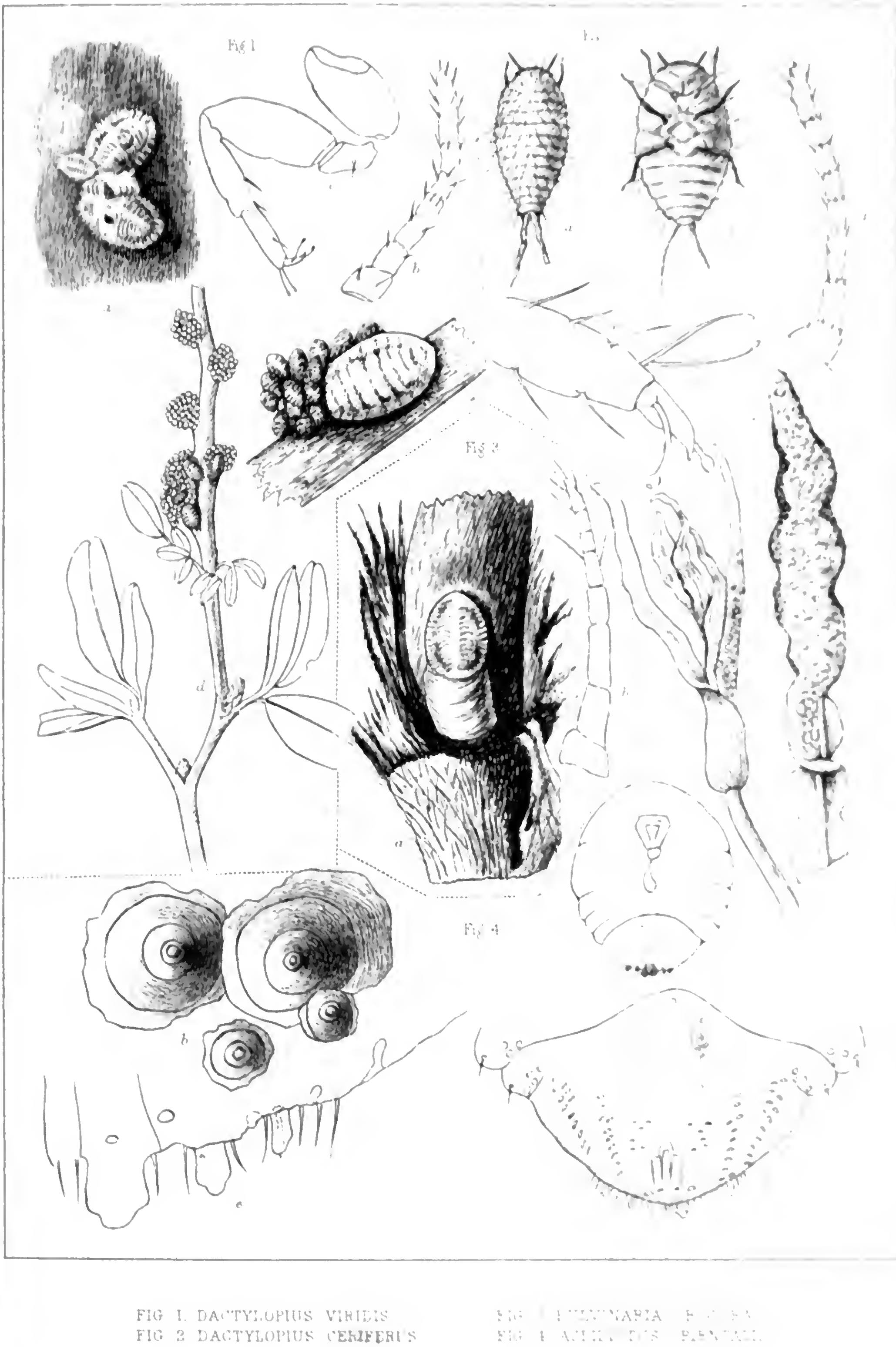


FIG 1. DACTYLOPIUS VIRIDIS
FIG 2 DACTYLOPIUS CERIFERUS

FIG [illegible] [illegible]NARIA [illegible]
FIG 4 [illegible]

Photo-etching from the Original Drawing - Survey of India Offices Calcutta [illegible]

Vol. III.] [No. 6.

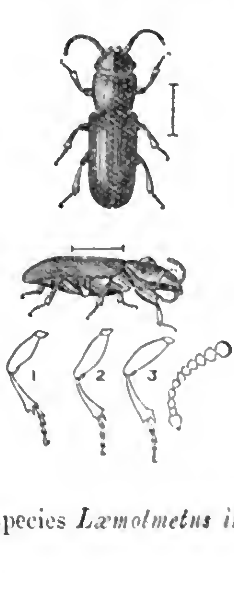
MISCELLANEOUS NOTES FROM THE ENTOMOLOGICAL SECTION.

BY E. C. COTES,

DEPUTY SUPERINTENDENT, INDIAN MUSEUM.

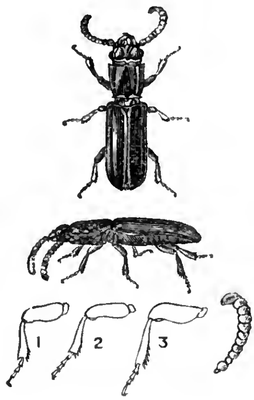
The following figures have been prepared from time to time in the Entomological Section of the Indian Museum in illustration of insects of economic importance in India. Most of the species concerned have already been more or less completely discussed in the pages of these *Notes*, and, in now publishing figures, the intention is merely to facilitate their identification. It has been thought necessary therefore to give little more than references to the pages where further particulars will be found. With a few exceptions, which are noted in each case, the figures have been drawn from specimens in the Museum collection. When not otherwise acknowledged the drawings are the work of Baboo G. C. Chuckarbutty and other native artists from time to time employed in the Entomological Section. The wood-cuts have been prepared in the Government School of Art, while the photo-blocks come from the Photo-lithographic Office of the Survey Department of India.

The writer would take this opportunity to acknowledge the great assistance which has been uniformly afforded to him, in the preparation of the numerous numbers of *Indian Museum Notes*, *Notes on Economic Entomology*, and other official publications, both by Colonel J. Waterhouse, to whom the Museum is chiefly indebted for some exquisite photo-etchings, and also to Messrs. Dean and Ross, who have successively been in charge of the Government Press where the reports have been printed.

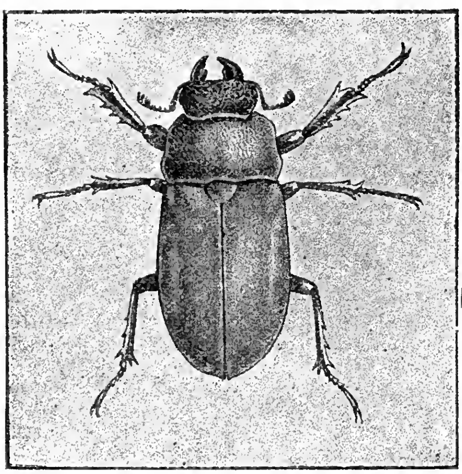


The above shows the species *Læmolmetus insignis*, Grouville, referred

to in these *Notes,* Vol. III, p. 22, as one of the insects infesting the timber of the tree *Terminalia belerica* in the Bombay Presidency. The natural size of the insect is indicated by hair lines.

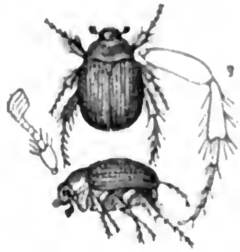


The above shows a beetle belonging to the species *Hectarthrum brevifossum,* Newm., as determined in the Indian Museum collection. It emerged in the Museum from a block of *Shorea assamica* wood received through the Forest School from the Deputy Conservator of Forests, Lakhimpur, Assam, August 1891. The wood was badly tunnelled by the larvæ of a large species of Cerambycidæ upon which the *Hectarthrum* is possibly parasitic.

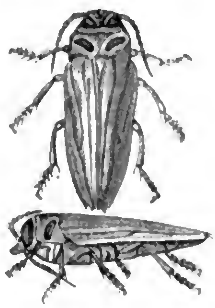


The above shows the female of the species *Lucanus lunifer,* Hope, referred to in these *Notes,* Vol. II, p. 148, in connection with in-

jury to oak trees in Naini Tál. The figure is natural size after Thompson.



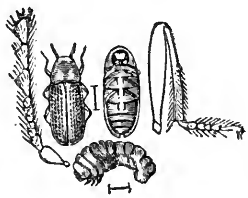
The above shows an insect belonging to the species *Sericea pruinosa*, Burm., as determined in the Indian Museum collection. It has been sent to the Museum as injuring the foliage of the coffee tree in Travancore.



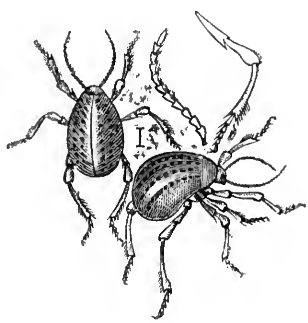
The above shows the species *Belionota scutellaris*, Fabr., natural size. The insect is referred to in these *Notes*, Vol. II, p. 149, in connection with injury to *Acacia catechu* timber.

The above shows the Buprestid *Psiloptera fastuosa*, Fabr., natural

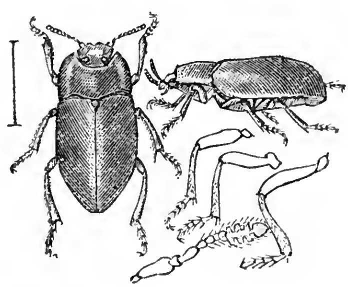
size. It is referred to in these *Notes*, Vol. II, p. 45, in connection with injury to teak trees in the Madras Presidency.



The above figure is taken from specimens of the common Calcutta book-worm (*? Sitodrepa panicea*, Linn.). It shows the beetle dorsal and ventral view with details of the appendages, also a full-grown larva. The natural size is indicated by hair lines.

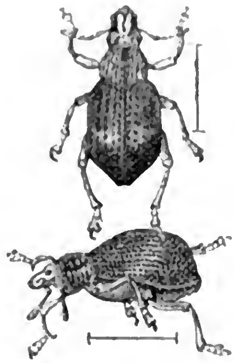


The above shows the insect referred to in these *Notes*, Vol. I, p. 106, under the name of *Gibbium scotias*, Fabr. It was sent to the Museum in connection with injury to opium cakes in Behar. The natural size is indicated by a hair line.



The above shows the insect referred to in these *Notes*, Vol. II,

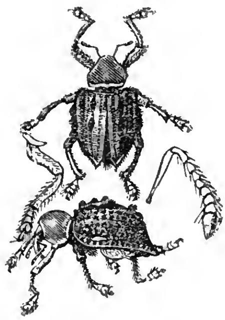
p. 150, under the name of *Opatrum depressum*, Fabr. It was sent to the Museum in connection with injury to linseed and wheat crops. The natural size is indicated by a hair line.



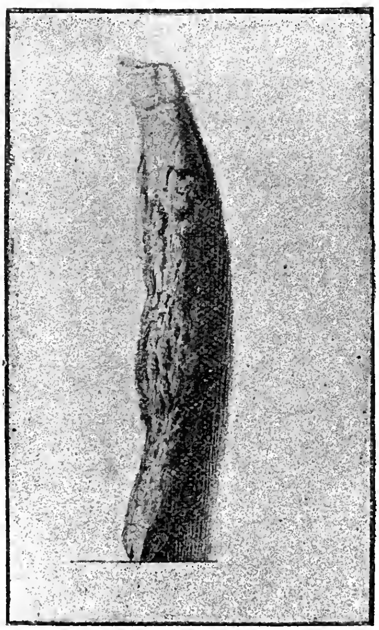
The above shows the Curculionid *Episomus crenatus*, Dej., referred to in these *Notes*, Vol. III, p. 117. The figure is enlarged, the natural size being indicated by hair lines.

The above, which is taken from a photograph one-sixth natural size, shows a block of date palm from Lucknow tunnelled by the larvæ

of the palm weevil *Rhynchophorus ferrugineus.* An account of the insect is given in these *Notes,* Vol. II, p. 8.

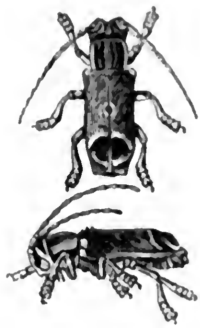


The above shows the Curculionid *Desmidophorus hebes,* Fabr., referred to in these *Notes,* Vol. I, p. 58. The insect is reproduced natural size, with enlarged diagram of an antenna and hind leg.

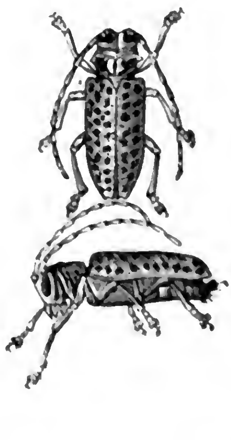


The above figure is copied from a photograph by the writer, of a piece of stem of a young teak tree from the Kulsi plantation, Assam,

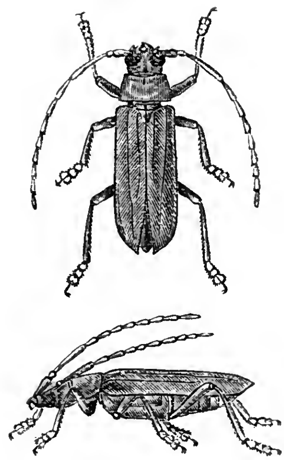
to show the swelling caused by the attack of Cerambycidæ larvæ. The figure is about one-eighth natural size.



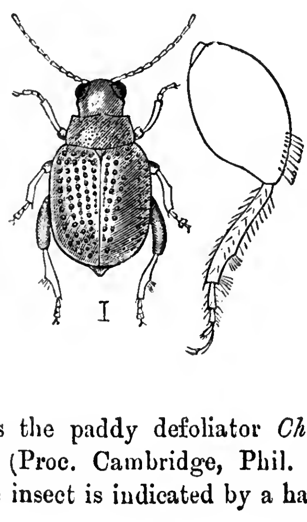
The above shows the Cerambycid *Sthenias grisator*, Fabr., referred to in these *Notes*, Vol. III, p. 110. The figure, which is natural size, shows the mature beetle which is said to have a pernicious habit of girdling the stems of rose bushes.



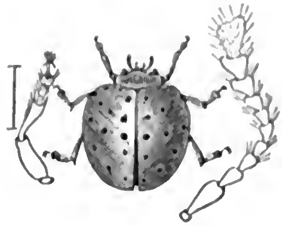
The above shows the species *?Cœlosterna spinator*, Fabr., referred to in these *Notes*, Vol. III, p. 114, in connection with injury to Babul trees in Dehra Dun. The figure is natural size.



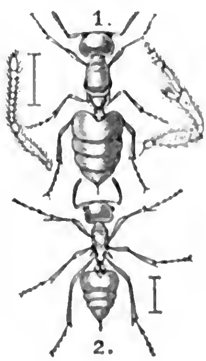
The above shows the Cerambycid *Ægosoma lacertosum*, Pascoe, referred to in these *Notes*, Vol. II, pp. 12 and 154, in connection with injury to teak trees in the Kulsi teak plantation, Assam. The figure shows the mature insect, natural size.



The above shows the paddy defoliator *Chætocnema basalis*, Baly, after Shipley's figure (Proc. Cambridge, Phil. Soc., Vol. VI, pt. 6). The natural size of the insect is indicated by a hair line.

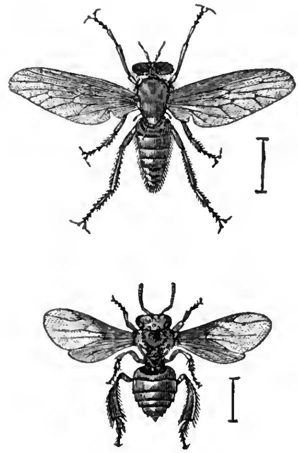


The above shows the Coccinellid *Epilachna 28-punctata*, Fabr., referred to in these *Notes*, Vol. I, p. 58, also Vol. II, p. 45, in connection with injury to Brinjal and other plants.

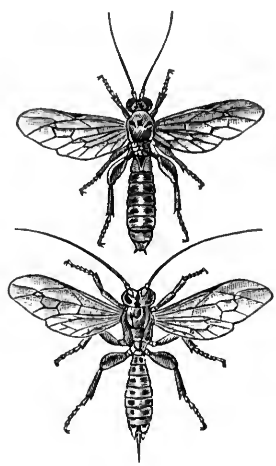


The above shows the ant *Cremastogaster dohrni*, Meyr., referred to in these *Notes*, Vol. III, No. 3, p. 117, as a troublesome pest on cinchona and coffee bushes in Ceylon.

The forms figured are (1) the female as she appears after dropping her wings, and (2) the worker major.

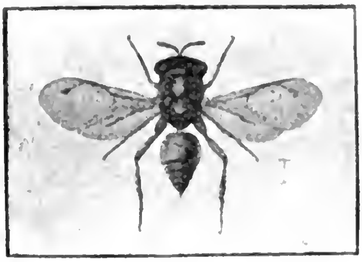


The above illustrates an interesting case of mimicry discovered by Major C. T. Bingham in Moulmein, Burma. The figures are taken from specimens presented to the Indian Museum by Major Bingham. The lower figure shows the bee *Trigona vidua*, St. Farg. The upper shows an Asilid fly which mimics it so closely in size and coloration, as to be almost indistinguishable when upon the wing, in spite of its great structural diversity. The Asilid figured was taken in the act of devouring the bee.

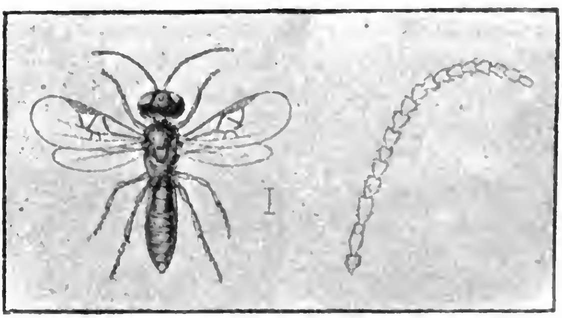


The above shows the Ichneumonid *Pimpla punctator*, Linn., male

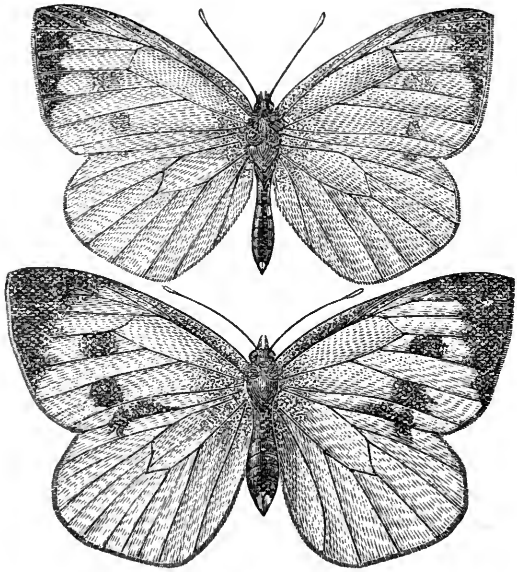
and female, natural size, as determined in the Indian Museum collection. The species has been reared in the Museum from several species of Saturniidæ upon which it is parasitic. In these *Notes*, Vol. II, pt. IX, is figured a parasitized cocoon of *Antheræa roylei*, Moore, cut across to show the cells formed by the larvæ of the *Pimpla*.



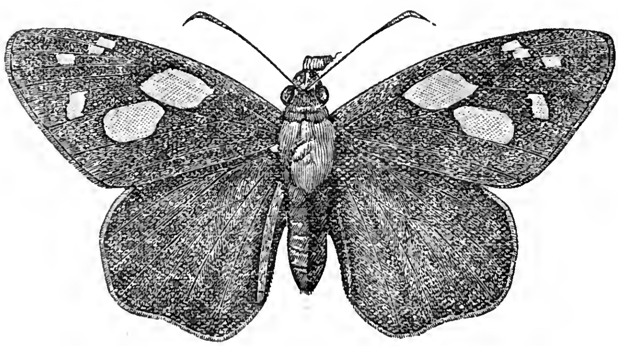
The above figure was drawn from typical specimens of the species described by Cameron under the name *Pteromalus oryzæ*. The insect was taken by the writer in Calcutta, in February 1888, in close association with the weevil *Calandra oryzæ*, Linn., upon which it is likely to be parasitic. The natural size is indicated by a hair line.



The above shows the Chalcid referred to in these *Notes*, Vol. I, p. 29, as an important agent in keeping down the number of the Sorghum borer (*? Diatræa* sp.). The species has since been described by Cameron (Proc. Man. Lit. and Phil. Soc., 1890-91) under the name *Colesia flavipes*. The figure which shows the insect enormously enlarged is after Cameron.

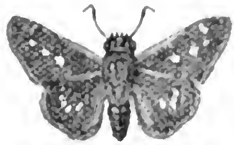


The above shows the Pierid *Mancipium nepalensis,* Grey, male and female, as determined in the Museum collection. The caterpillar of this species is referred to in these *Notes,* Vol. II, p. 46, as attacking various garden and field crop plants in Umballa. The species may be looked upon as little more than the Indian form of the destructive European species *Pieris* (*Mancipium*) *brassicæ,* Linn.

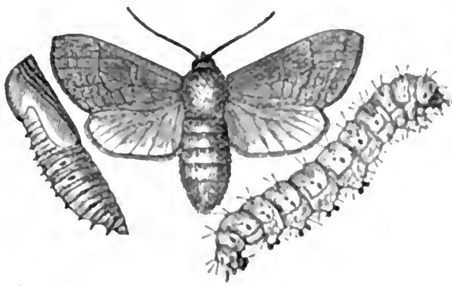


The above shows the Hesperid *Gangara thyrsis,* Fabr., reared from the

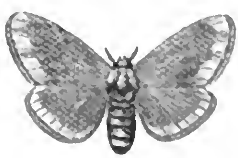
caterpillars referred to in these *Notes*, Vol. I, p. 204, as defoliating young cocoanut palms in Malabar. The insect is shown natural size.



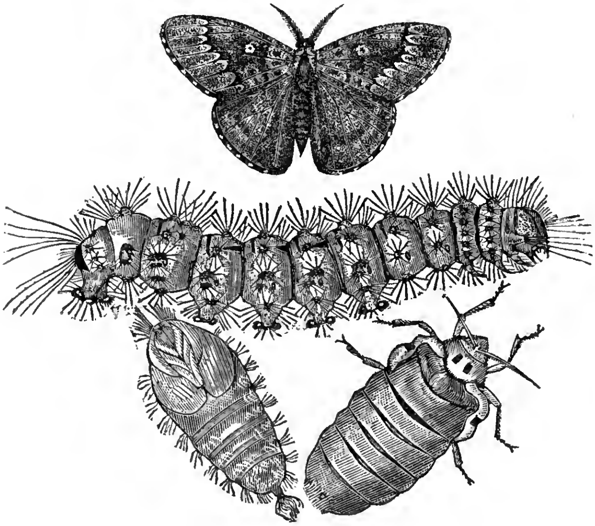
The above shows the Hesperid reared from the caterpillar referred to in these *Notes*, Vol. III, p. 113, under the name *Parnara colaca*, Moore, as attacking young paddy in Saran. The figure is natural size.



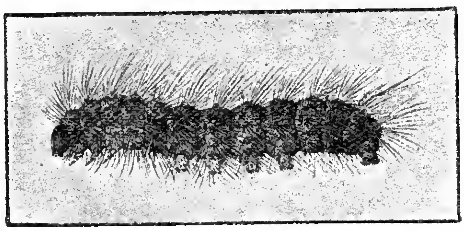
The above shows the Travancore teak borer in various stages of development, natural size, from specimens furnished to the Museum by Mr. J. F. Bourdillon. The insect is referred to in these *Notes*, Vol. I, p. 198, also Vol. III, p. 113. It has been determined by Mr. F. Moore as allied to the species *Cossus cadambæ*, Moore.



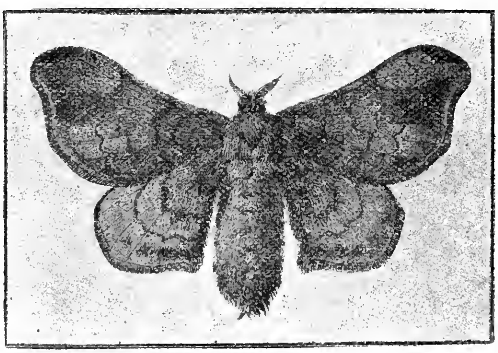
The above shows the moth reared from the caterpillars referred to in these *Notes*, Vol. II, p. 38, as attacking young mango trees in Poona. The insect has been determined as belonging to the species *Arlaxa limbata*, Butler. The figure is natural size.



The above shows various stages in the development of the species which attacks the foliage of the peepul tree in Bengal. It has been determined as belonging to the species ***Enome ampla,*** Walker.



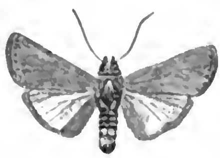
The above shows the caterpillar, natural size, of the species ***Alope ricini,*** Fabr. This insect occurs throughout India, where it is a general defoliator.



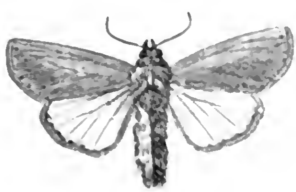
The above shows the female, natural size, of the wild silk moth ***Aris-***

thala sikkima, Moore, forwarded to the Museum from Cachar. The male moth, also the cocoon, of this species are figured in these *Notes,* Vol. III, p. 135.

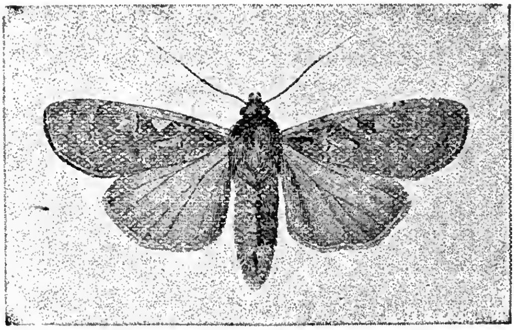
The above shows the imago of a wild species of silk-producing Bombycidæ (probably *Gunda javanica,* Moore,) forwarded to the Museum in August 1891 from Cachar where the caterpillar is said to feed upon the leaves of a species of rubber tree.



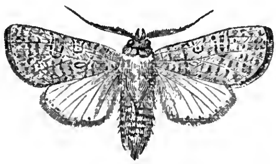
The above shows the moth, natural size, of a species whose caterpillar has been forwarded to the Museum as defoliating the lentil plant in Patna. The insect is referred to in these *Notes,* Vol. II, p. 10, under the name *Laphygma exigua,* Guer.



The above shows the imago of a caterpillar which has been reported as exceedingly destructive to paddy in the Central Provinces. The insect is referred to in these *Notes* under the name *Leucania loreyi,* Dup.

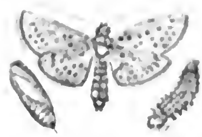


The above shows the moth of the destructive cut worm *Ochropleura flammatra*, Linn., referred to in these *Notes*, Vol. II, p. 6, in connection with injury to poppy plants. The figure is natural size.

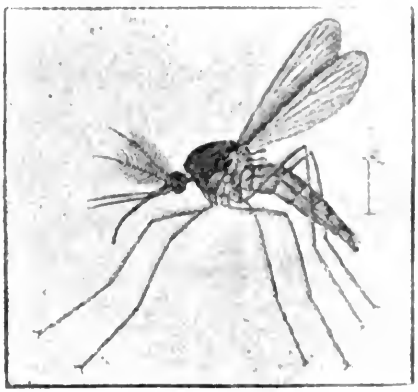


The above shows the imago, natural size, of the cosmopolitan species *Agrotis segetum*, Schiff. It is referred to in these *Notes*, Vol. II, pp. 7 and 161, in connection with injury to young coffee plants.

The above shows the moth, also the chrysalis lying in its earthen cell, reared from caterpillars destructive to garden plants both in Calcutta and in Dehra Dun. The insect is referred to in these *Notes*, Vol. II, p. 160, under the name *Polytela gloriosa*, Fabr.

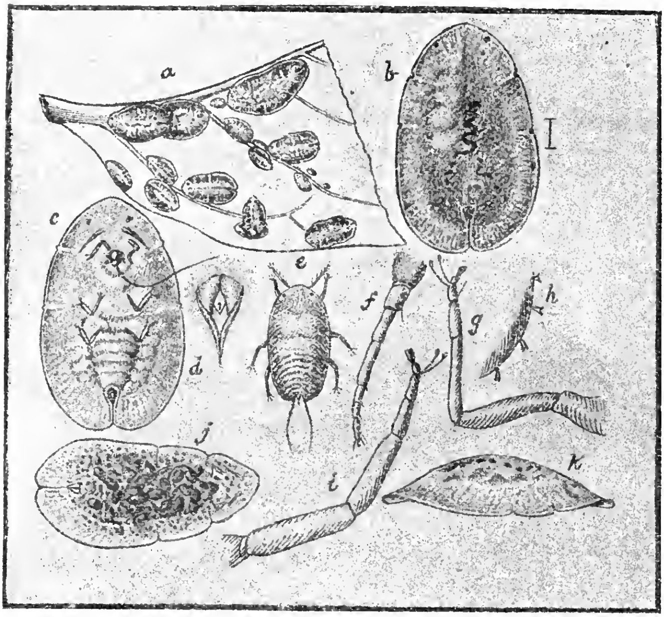


The above shows various stages in the development of the species, *Conogethes punctiferalis*, Guen., referred to in these *Notes*, Vol. III, No. 5, p. 81, as attacking the fruit of *Garuga pinnata*, Roxb., in Poona.



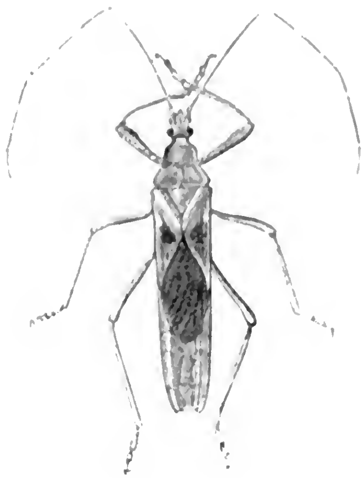
The above shows the male of the brown mosquito of Bengal (*Culex pipiens*, Linn.). The natural size is indicated by a hair line. The female of this species, also its larva and pupa, are figured in these *Notes*, Vol. III, pp. 136 and 137.

The above shows various stages in the development of the Baluchistan melon fly *Carpomyia pardalina*, Bigot. The natural size in each case is indicated by a hair line.

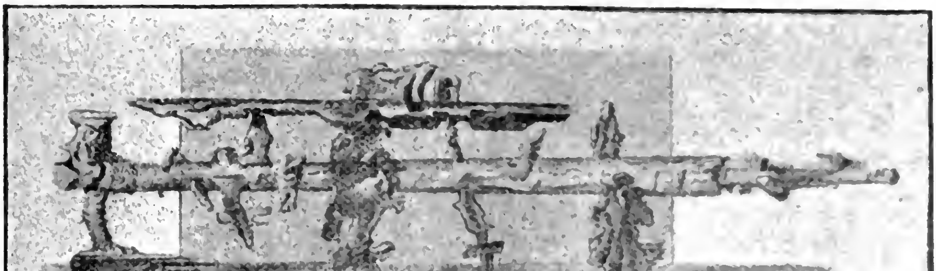


The above is reproduced from some excellent drawings furnished by Mr. E. E. Green, in illustration of the life history of the scale insect *Lecanium viride*, Green, referred to in these *Notes*, Vol. I, pp. 49 and 113. The following is an explanation of the letters used :—

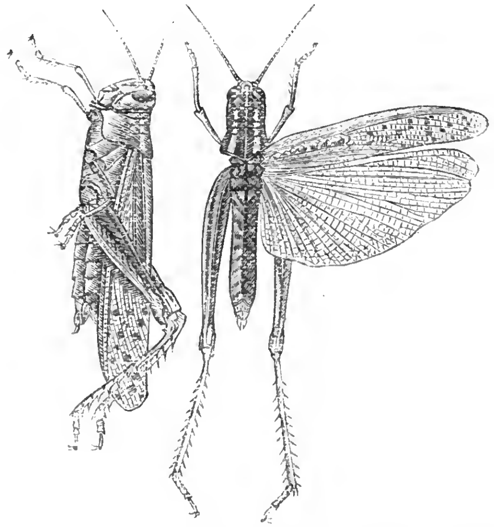
a. Portion of coffee leaf, with scale insects, enlarged.
b. Adult ♀, dorsal aspect, magnified 10 diameters.
c. Ditto, ventral ditto ditto.
d. Ano-genital aperture of ♀, enlarged (from above).
e. Young larva, just hatched from egg, highly magnified.
f. Antenna of adult ♀, enlarged.
g. Leg (left third) of adult ♀, enlarged.
h. Margin of scale, enlarged, showing marginal hairs.
i. Leg (right second) of adult ♀, enlarged.
j. Adult ♀, enlarged, viewed with transmitted light showing oval within the body.
k. Adult ♀, side view, enlarged.



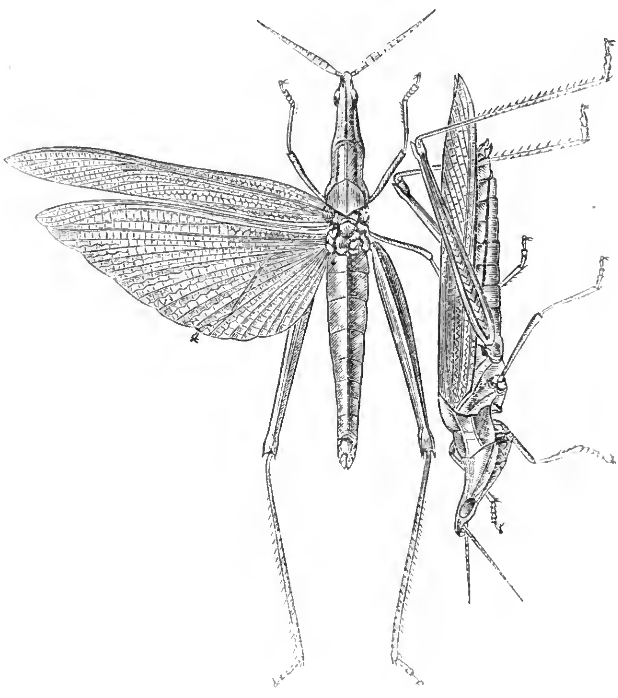
The above shows the Lygaeid *Lohita grandis*, Grey, referred to in these *Notes*, Vol. II, p. 166, as attacking the cotton plant. The figure is natural size.



The above shows the remains of a beam of wood from the neighbourhood of Calcutta, which had been attacked by white ants. The species responsible is likely to have been the *Termes taprobanes*, Walker, referred to in these *Notes*, Vol. III, p. 140. The figure, which is about one-seventh natural size, shows the supports left by the insects to bear the weight of the earth and rubbish that lay above the beam. Most of these supports, but not all of them, consist of a knob in the centre strengthened by a little of the surrounding wood-tissue.

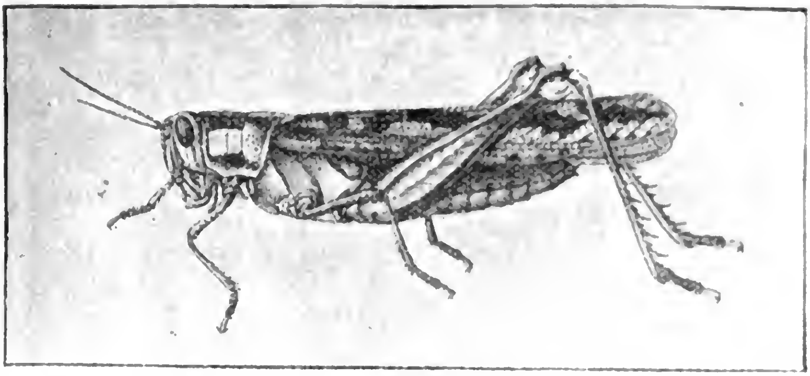


The above shows the Acridid *Euprepocnemis bramina*, Sauss, referred to in numerous places in these *Notes* as attacking various standing crops in India. The figure is natural size.

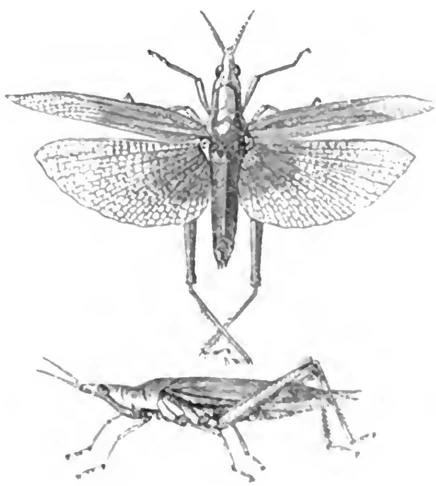


The above shows the Acridid *Tryxalis turrita*, Linn., referred to in

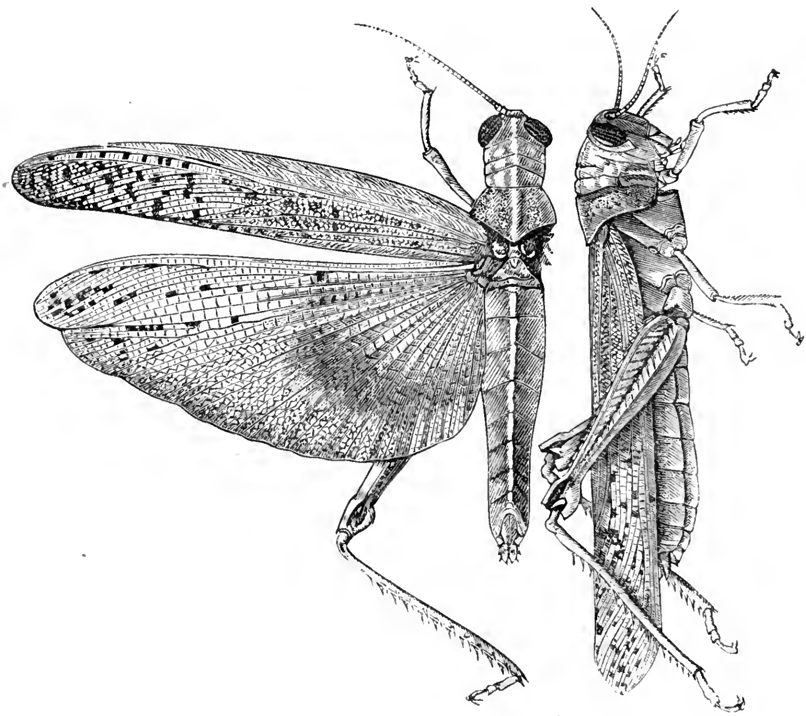
these *Notes*, Vol. II, pp. 27, 103, 104, 171, etc., in connection with injury to various standing crops in different parts of India. The figure is natural size.



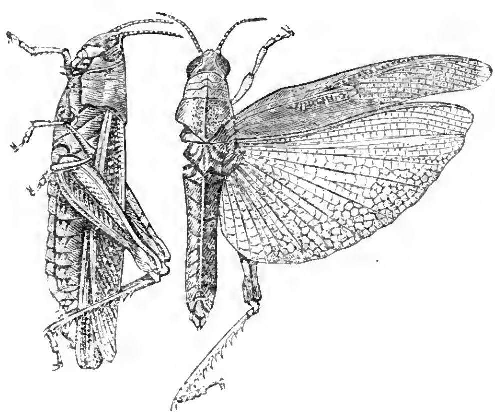
The above shows the Acridid *Acridium aeruginosum*, Burm., referred to in various places in these *Notes*, in connection with so-called "locust invasions," especially in the Madras Presidency. The figure, which is natural size, is taken from specimens received from Madras. Considerable individual variation is exhibited in the arrangement of the wing markings, even in specimens forwarded together from the same locality.



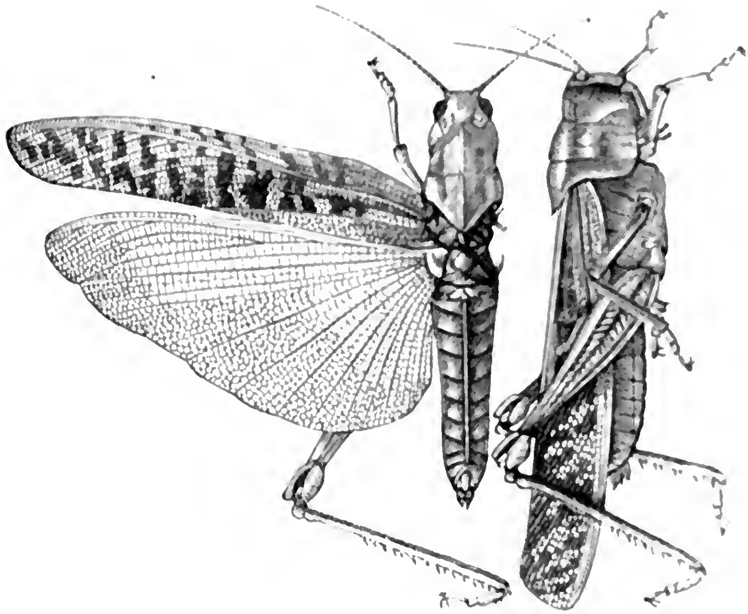
The above shows the Acridid *Atractomorpha crenulata*, Fabr., referred to in various places in these *Notes*, in connection with damage by so-called "locusts" to standing crops. The figures are natural size.



The above shows the species *Acridium melanocorne*, Serv., referred to in these *Notes*, in connection with injury to standing crops by so-called "locusts." The figures are natural size.



The above shows the species *Catantops axillaris*, Sauss., referred to in these *Notes*, Vol. III, No. 1, p. 30, in connection with injury to paddy in Bengal.



The above shows the Indian form of the well-known palæarctic locust *Pachytylus cinerascens*, Fabr. The species has been sent to the Indian Museum, in connection both with the Madras locust invasion of 1878 and also with more localized injury to standing crops in Ganjam in 1890. It would seem, however, to be a far less serious enemy to standing crops in India than such species as *Acridium peregrinum*, Oliv., and *Acridium succinctum*, Linn.

G. I C. P. O.—No. 229 R. & A.—5-5-06.—1,000.